

FLOWER MITES OF TRINIDAD II. THE GENUS *PROCTOLAE LAPS* (ACARI: ASCIDAE)

Barry M. O'Connor¹, Robert K. Colwell², and Shahid Naem¹

ABSTRACT.—Nine species of mites of the genus *Proctolaelaps* were collected in flowers or phoretic in the nares of hummingbirds in Trinidad. Previously named species *P. kirmsei*, *P. glaucis*, and *P. belemensis* are redescribed, and six new species are described: *P. jurgatus*, *P. mermillion*, *P. rabulatus*, *P. contumex*, *P. certator*, and *P. contentiosus*. *Proctolaelaps belemensis cyanocompsae* is raised to specific status. Host plants are given for all species except *P. mermillion*, which was collected only from a hummingbird host. New World flower-inhabiting *Proctolaelaps* are grouped into two hypothetically monophyletic lineages, the *kirmsei*-group and the *belemensis*-group, on the basis of adult morphology. A key to the nine Trinidadian species is given.

Key words: *Trinidad*, *flower mite*, *Proctolaelaps*, *Ascidae*, *hummingbird*.

Mites of the family Ascidae are common inhabitants of flowers in tropical and subtropical regions of the New World. Most of these flower-inhabiting species disperse through phoretic association with hummingbirds, although some have been collected from other bird groups and from Lepidoptera. The mites are typically carried in the nares of the bird. This is the second report on the systematics of these mites based on studies carried out on the island of Trinidad during the years 1975–1982 by field teams led by one of us (RKC). Three genera of Ascidae include species exhibiting flower-bird associations. We have previously reported on the two Trinidadian species belonging to the predatory genus *Lasioseius* (Naem et al. 1985). This paper will deal with species of the genus *Proctolaelaps*, while the third genus, *Rhinoscius*, will be considered in a final report (O'Connor et al., in preparation).

Species of *Proctolaelaps* have been described from flowers in Africa (Ryke 1954, 1964) and from nectarivorous vertebrates from Australia (Domrow 1979). Fain et al. (1977a) first reported *Proctolaelaps* from the nares of hummingbirds from the New World, briefly describing four new species: *P. hunteri*, *P. kirmsei*, *P. glaucis*, and *P. belemensis*. Those authors later (Fain et al. 1977b) gave more complete descriptions of these species and described a new subspecies, *P. belemensis cyanocompsae*, from the nares of a cardinaline finch, *Passerina (=Cyanocompsa) cyanoides*. Hyland et al. (1978) gave new host and locality records for *P. kirmsei* and *P. belemensis* and described two new species, *P. mexicanus* and *P. spiralis*, the former from the nares of a tanager, *Euphonia hirundinacea*.

Fain et al. (1977b) noted that all of the New World bird-phoretic *Proctolaelaps* shared certain unique morphological characteristics, notably the reduced cheliceral dentition and the presence of a large ventral spurlike seta on femur IV of the male. These characteristics are also found in the Australian species *P. spencerae* Domrow, 1979, but not in the African flower-inhabiting *P. vanderbergi* and *P. proteae* (Ryke 1954). Fain et al. (1977b) regarded the systematic position of the hummingbird-associated *Proctolaelaps* as uncertain, noting,

We have placed all these species in the genus *Proctolaelaps* but it is quite possible that some or all belong to another perhaps undescribed genus intermediate between *Rhinoscius* and *Proctolaelaps* (p. 127).

In his recent revision of *Proctolaelaps*, Karg (1985) made no mention of any of these New World or Australian species. In his taxonomic arrangement, in which subgenera and species groups were based on single character differences, all of the flower-inhabiting species would belong to the *pygmaeus* species group of the subgenus *Proctolaelaps* (sensu stricto).

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It might appear that the character states noted above that are shared by the New World flower-inhabiting *Proctolaelaps* and the Australian *P. spencerae* are synapomorphies, suggesting a common ancestry. However, some caution is necessary before accepting this conclusion. It should be noted that similar character states (i.e., reduced cheliceral dentition and spurs on male femora IV) are found in the ameroiseiid genus *Hattena*, a genus known previously only from the nares of nectarivorous birds (Meliphagidae) from Australia (Domrow 1979). We have obtained specimens of *Hattena cometis* Domrow, 1979, from flowers of *Castanospermum australe* in Sydney, Australia, verifying that these mites are ecologically similar to the New World flower mites. Reduction in cheliceral dentition appears to be correlated with the switch from predation to nectar-feeding in ascid and ameroiseiid mites. Similarly, male armature is a correlate of the agonistic behavior exhibited by males toward each other (Colwell 1979, 1985, 1986a). Given the obvious convergence in morphology between flower-inhabiting *Proctolaelaps* and *Hattena*, the monophyly of the flower inhabiting *Proctolaelaps* of Australia and the New World must be tested using additional characters.

The New World flower-inhabiting *Proctolaelaps* that we have examined can easily be separated into two hypothetically monophyletic groups, the "kirmsei-group," and the "belemensis-group." These species groups are diagnosed below.

Observations on the ecology, behavior, and host associations of flower-inhabiting *Proctolaelaps* have been given by Colwell (1979, 1985, 1986a, 1986b), Dobkin (1984, 1985), and Heyneman et al. (1990). Because completion of our taxonomic studies on the Trinidad flower mites has lagged behind publication of ecological and behavioral studies, some species names have previously appeared as nomina nuda (Dobkin 1985, Colwell 1986a, 1986b, Heyneman et al. 1990). These names are validated here.

METHODS AND MATERIALS

Field studies were carried out during the period 1975–1982 at a variety of sites in Trinidad's Northern Range. The range consists of several parallel mountainous ridges

that form valleys oriented primarily in a north-south direction. The mountains reach about 1000 m in height. From east to west, the principal valleys from which our collections were made are the Arima, Guanapo, Aripo, and Oropuche valleys. The last contains localities from which mites had been previously collected by T. H. G. Aitken from 1954 to 1966 (Fain et al. 1977b). Most of our collecting efforts were concentrated in the Arima Valley along the Arima and Blanchisseuse roads; the latter runs through the Northern Range to the north coastal town of Blanchisseuse. Many collections were made near the Simla Research Station, owned and operated by the Asa Wright Nature Center, at 200 m elevation in the Arima Valley. The habitat is humid montane seasonal tropical rain forest with annual rainfall of 100–250 cm. The dry season occurs from January to April, the wet season from May until December. Although there are several government-managed forest reserves in the Northern Range, pristine or mature areas of forest are rare. Our collection sites were often in these forest reserves, which were largely secondary growth or under cultivation by individual farmers. Agricultural methods include slash-and-burn techniques, and during dry years extensive areas of the valleys are burned. The most disturbed areas occurred in the eastern valleys.

Most of the hummingbird-pollinated plants from which mites were collected (all indigenous species) thrive in secondary and disturbed habitats. Our collections from host plants and from birds were therefore primarily from roadsides, disturbed habitats bordering small farms, and secondary tropical rain forest. Few collections were made in mature rain forest. One additional collecting locality, Waller Field, lies 11.6 km southeast of the Simla station. This site was once a lowland (30 m) tropical rain forest but is largely secondary habitat now. A few patches of rain forest persist there, but the area is mostly young trees, shrubs, and herbs. This area, an abandoned military air field, is favorable for many of the species of plants harboring flower mites. Further descriptions of the habitats can be found in references in Dobkin (1985).

In the field, flowers or flower bracts were removed from the plant and placed in individual vials of 70% ethanol. Additional specimens were collected from hummingbird

hosts by capturing the birds in mist nets and aspirating the mites from the nares. Birds were identified and released. Mites were cleared and mounted in Hoyer's medium in the laboratory.

Our specimens were compared with the holotypes of named species in the laboratory of Dr. Alex Fain in Antwerp, Belgium. It should be noted that the holotypes of species described by Fain et al. (1977a) were stated to have been deposited in the U.S. National Museum of Natural History in Washington. Through the courtesy of Dr. Fain, one of us (BMOC) was able to study these specimens in Dr. Fain's laboratory in 1983. According to Mr. Robert Smiley, Systematic Entomology Laboratory, USDA (personal communication, 1990) the specimens have not been received by the National Museum and are presumably still in the collection of Dr. Fain.

Types and voucher specimens from our studies are deposited in the following institutions: University of Michigan Museum of Zoology, Ann Arbor, Michigan (UMMZ); Life Science Museum, Brigham Young University, Provo, Utah (BYU); U.S. National Museum of Natural History, Washington, D.C. (NMNH); Canadian National Collection of Arthropods, Biosystematics Research Centre, Ottawa, Ontario, Canada (CNC); L'Institut Royal des Sciences Naturelles, Brussels, Belgium (IRSNB).

In the following descriptions, all measurements are given in micrometers (μm). For new species, measurements are given as follows: holotype, mean (range) (number of specimens measured). For the other sex and for previously described species, measurements are given as mean (range) (number of specimens measured). For each species, 10 individuals of each sex including individuals from all host plants were measured when available.

SPECIES ACCOUNTS

The Proctolaelaps kirmsei group

The *Proctolaelaps kirmsei* group may be diagnosed by the narrow rows of deutosternal teeth and the modification of certain leg setae in the male: the three ventral setae of femur II are enlarged and spinelike; the enlarged seta v of femur IV is partially fused to a cuticular projection of the segment; and setae av1–2, pv1–2, and mv of tarsus II, seta avI of genu

IV, and setae avI and pvI of tibia IV all share a unique structure. The bases of these setae are inflated ventrally, with the filiform part of the seta projecting from the base at an angle. Narrow deutosternal tooth rows occur in some nonflower-inhabiting *Proctolaelaps*, but the modifications of the male legs are unique synapomorphies not occurring in any other *Proctolaelaps* species. Modification of some setae of tarsus II in the male is known in the genus (e.g., *P. subcorticalis* Lindquist, 1971); however, the particular form of the setae in these flower mites is unique. Described species having this set of derived characters include *P. kirmsei* and *P. glaucis*. Published descriptions of *P. hunteri* and *P. mexicanus* mention or illustrate the partially fused seta and tubercle of femur IV and the spinelike setae ventrally on femur II, and mention the presence of "spines" on tarsus II, but the text and figures are not specific as to the form or homology of the "spines." We regard these species as also belonging to this group, pending reexamination of the tarsal setation. Five species belonging to this group were collected in Trinidad: *P. kirmsei*, *P. glaucis*, and three new species.

Proctolaelaps kirmsei Fain, Hyland and Aitken, 1977

Proctolaelaps kirmsei Fain, Hyland and Aitken, 1977a: 185

Proctolaelaps kirmsei Fain, Hyland and Aitken, 1977b: 131

Proctolaelaps kirmsei Hyland, Fain and Moorhouse 1978: 263

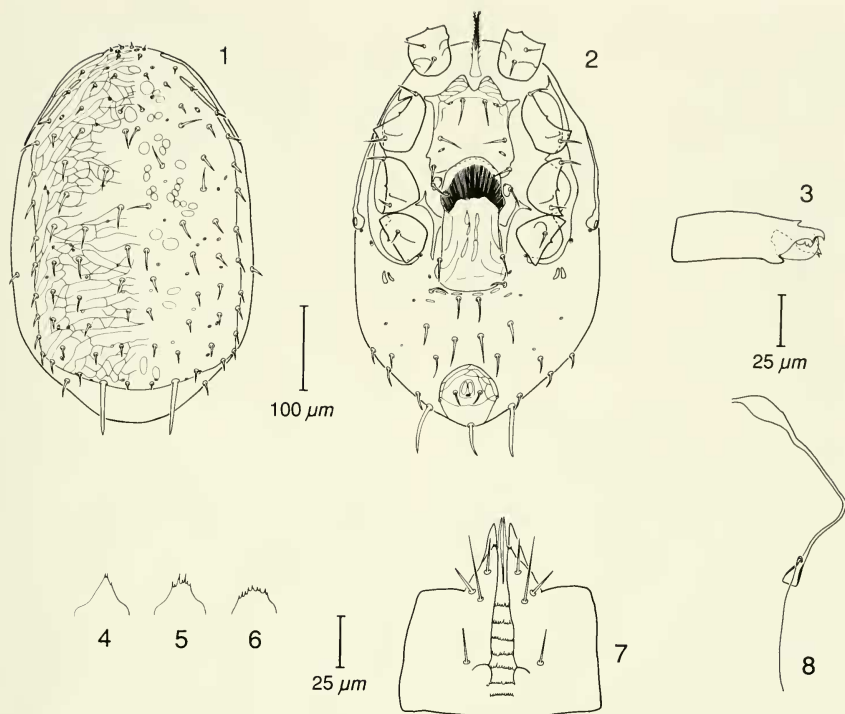
Proctolaelaps kirmsei Colwell, 1985: 59

Proctolaelaps kirmsei Colwell, 1986a: 408

Proctolaelaps kirmsei Colwell, 1986b: 485

Proctolaelaps kirmsei Heyneman et al., 1990: 458

This species was briefly diagnosed from a male and a female specimen collected from the nares of *Phaethornis augusti* from Birongo, Venezuela (Fain et al. 1977a). Fain et al. (1977b) provided some additional measurements and a figure of the male. They noted that all female specimens were in poor condition. Hyland et al. (1978) reported a single female from *Phaethornis superciliosus* from Veracruz, Mexico. Detailed observations on the ecology and host-plant associations of this species in Trinidad have been presented by Colwell (1985, 1986a) and Heyneman et al. (1990). We give here a complete description and figures of both sexes based on our Trinidad material. Our specimens were compared with the holotype.



Figs. 1-8. *Proctolaelaps kirmsei*, female: 1, dorsum; 2, venter; 3, chelicera; 4-6, variation in tectum form; 7, subcapitulum, ventral view; 8, spermathecal system.

FEMALE (Figs. 1-8).—Idiosomal length 483 (450-509), width 308 (287-322); dorsal shield length 452 (410-486), width 276 (252-304) ($n = 10$). Dorsal shield (Fig. 1) with reticulate pattern over entire surface. Dorsal shield with 44 pairs of smooth, simple setae; marginal setae r2-r6 and R1-R6 on edge of shield, R7 on membrane posterior to shield; 3 pairs of submarginal setae (UR) on lateral membrane posteriad of coxae IV. The following measurements of dorsal setae were taken from the figured specimen, a mite of average body size: setae j1-4, z1-3, and s1-2 very short (7-11 μm), setae j5-6, z4-6, and s3-6 distinctly longer (22-29 μm), anterior marginal setae (r2-6) intermediate in length (13-18 μm); posterior half of shield with J1 (24 μm) longer than other setae, most of which are approximately 13 μm long, exceptions are

the very short J5 (6 μm) and the large, stout Z5 (68 μm). Glands, proprioceptors, and muscle scars positioned as indicated in Figure 1.

Venter (Fig. 2) with tritosternum with elongate base and slender, tapering, pilose laciniae. Sternal shield longer than wide, with 3 pairs of setae and 2 pairs of pores, anterior lobes of shield well developed, with distinct linear pattern. Fourth pair of sternal setae and 3rd pair of sternal pores on metasternal platelets. Genital shield with linear ornamentation, shield slightly widened behind genital setae. Four to six small sclerites positioned directly posterior to genital shield. Endopodal apodemes distinct between epigynial shield and coxae III-IV; exopodal sclerites extending from between coxae I-II to behind coxae IV. Two pairs of small, elongate metapodal plates. Anal shield ovoid, longer than

wide (average length 84 μm , width 76 μm), ornamentation confined to anterior two-thirds, postanal seta slender, about twice as long as paraanal setae. Posterior ventral region with 8 pairs of setae (Jv1-5, Zv1-3), Jv1 and Jv2 typically longer than other anterior setae, Jv5 stout and 60-70 μm long; posterior submarginal setae (UR) also typically visible ventrally (Fig. 2). Peritreme extending anteriorly to a point approximating base of dorsal seta z1. Spermathecal system consisting of a broad, membranous pouch just inside external opening, connecting with an adductor canal approximately 90 μm long; a small, bell-shaped maturation pouch lies at juncture of adductor canal and the long, thin spermiduct (Fig. 8).

Gnathosoma with tectum variably shaped, ranging from triangular with few teeth to broad and strongly toothed (Figs. 4-6). Chelicera with fixed digit bidentate; movable digit also bidentate with strong distal hook; a large, membranous process bearing 2 distal teeth present on paraxial face (Fig. 3). Deutosternum with 7 transverse rows of denticles; anterior 6 rows connected; no rows widened (Fig. 7). Rostral setae simple, slender, with internal posterior rostral setae at least twice as long as external posterior rostral setae; capitular setae slender, simple. Corniculi parallel; internal malae very thin, extending to or slightly beyond tip of corniculi. Palps similar to other *Proctolaelaps* species.

Legs I-IV (excluding pretarsi) 93, 73, 74, and 92% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxae II and III with pronounced convex boss, coxa IV with a weaker boss. Setation of genua of legs I, II, III, and IV, respectively, 13-11-9-9, that of tibia: 13-10-8-10; all leg setae setiform to filiform except the following spinelike setae: pd2 of femur II, ad1 of femur III, ad1 and ad2 of femur IV, and v of femur IV, which is strong and about as long as the segment width.

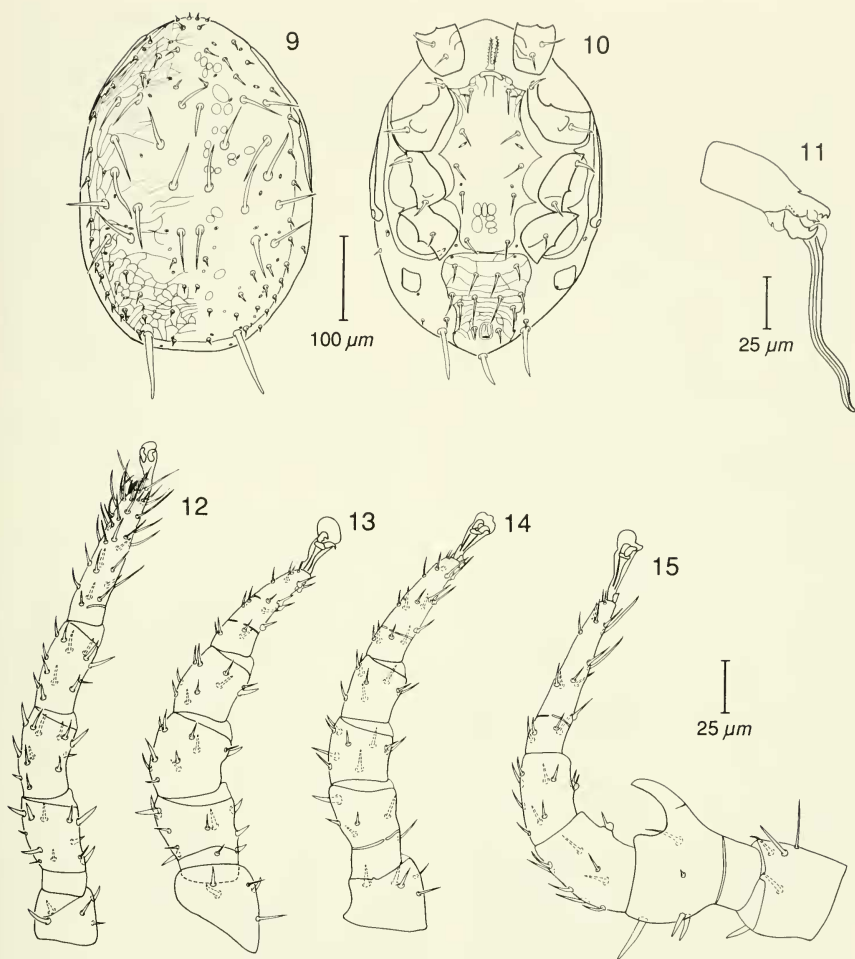
MALE (Figs. 9-15).—Idiosomal length 404 (382-422), width 281 (246-298) ($n = 10$). Reticulate pattern present on anterior and posterior quarters and laterally on shield, central half of shield with pattern very weak or absent (Fig. 9). Shield with 43-45 pairs of setae, posterior marginal (R) setae varying from 5 to 7 pairs, all on shield. One pair of submarginals (UR1) laterad of coxae IV. Ante-

rior dorsal setae j1-4, z1-3, s1-2 very short (10-15 μm); central dorsal setae j5-6 and J1, z4-6 and Z1, s3-6 and S1 are strong spines 45-55 μm long; posterior dorsal setae (except Z5) also short (10-15 μm), Z5 is a thickened, blunt spine, 75-80 μm long; all marginal setae short. Glands, proprioceptors, and muscle scars as shown in Figure 9.

Venter (Fig. 10) with tritosternum with base distinctly shorter than in female. Sternogenital shield with reticulation confined to anteriolateral corners, smooth medially and posteriorly, with 5 pairs of setae and 3 pairs of pores. Metapodal plates quadrate, much larger than in female. Ventrianal shield relatively narrow, not extending to metapodal plates, reticulated over entire surface, with 5 pairs of ventral setae on shield, Jv1-3, Zv1-2, in addition to paraanal setae. Three pairs of ventral setae (Jv4, Jv5, and Zv3) on membrane. Setae Jv1, Jv2, Jv3, and Zv2 relatively long and setiform (28-35 μm), Zv1 setiform and somewhat shorter (21 μm); Jv4 and Zv3 microsetae (7-9 μm), and Jv5 a thick, blunt spine, 50-65 μm long. Paraanal setae approximately half as long as thick, blunt postanal seta (30-40 μm). Peritremes much shorter than in female, extending anteriorly to the vicinity of seta s1. Endopodal apodemes fused to sternogenital shield; exopodal sclerites well developed laterad of coxae.

Gnathosoma with tectum simpler than in female, broadly rounded and with few or no teeth. Fixed digit of chelicera with one tooth and a bidentate, membranous process as in female; movable digit unidentate, with long, somewhat sinuous spermatodactyl projecting posteriorly, 97-106 μm long (Fig. 11). Corniculi shorter and stouter than in female, widely spread basally; other features of gnathosoma as on female.

Legs I-IV (excluding pretarsi) 92, 77, 72, and 97% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxa II with pronounced convex boss, coxa III with a weaker boss, coxa IV without boss. Leg I generally similar to female except some setae of femur slightly more spinelike. Leg II distinctly thickened, setae ad1, pd2, and all three ventral setae in the form of thick spines; genu and tibia each with seta pv a thick spine; tarsus with setae av1-2, pv1-2, and mv with thickened, bulbous base. Leg III with setation generally similar to female but with



Figs. 9–15. *Proctolaelaps kirmsei*, male: 9, dorsum; 10, venter; 11, chelicera; 12, leg I, dorsal view; 13, leg II; 14, leg III; 15, leg IV.

tarsal setae av1–2, pv1–2, and mv modified as on leg II. Leg IV strongly modified; femur enlarged, with ventral apophysis bearing partially fused, spurlike ventral seta, dorsal setae thickened and spinelike, especially ad1; genu with ventral seta with bulbous base; tibia with ventral setae av and pv likewise modified; tarsus with seta mv with bulbous base, setae av1 and av2 distinctly longer than pv1 and pv2. Pretarsi relatively long.

MATERIAL EXAMINED.—The following specimens were examined from the listed host plants in Trinidad: ex *Hamelia patens* Jacques (Rubiaceae), Arima Valley, Davis Road near Temple Village, 27 August 1980, D. S. Dobkin (#96) (31 females, 17 males); same data (#90) (1 female); same data (#89) (3 females, 2 deutonymphs); Andrews Trace, 10 mi N Arima, 21 February 1976, R. K. Colwell (#U53) (4 females); same locality, 23 February

1976, R. K. Colwell (#U54) (1 male); ex *Palicourea crocea* (Sw.) R. & S. (Rubiaceae), Arima Valley, Temple Village, dirt road near Cricket Pitch, 21 February 1979, R. K. Colwell (#T248) (1 male); Blanchisseuse Road, mile 9, 24 August 1980, D. S. Dobkin (#43) (3 females); same data, (#44), (#45) (numerous specimens); ex *Psiguria tryphylla* (Miq.) C. Jeffrey (Cucurbitaceae), Arima Valley, 50 m S Scott's Quarry, 17 February 1979, R. K. Colwell (#T219) (1 female, 2 males); ex *Costus scaber* Ruiz & Pavón (Zingiberaceae), Blanchisseuse Road, mile 19, 11 March 1979, R. K. Colwell (#T247) (2 females).

Specimens collected from hummingbirds include the following phoretic hosts: ex *Amazilia chionopectus chionopectus* (Gould), Arima Valley, Simla, 15–18 February 1976, R. K. Colwell (#U1, U2) (4 females); ex *Amazilia tobaci erythronotus* (Lesson), Arima Valley, Simla, 21–24 July 1975, R. K. Colwell (#T41, T42, T43) (7 females, 2 males); same locality, 15 February 1976, R. K. Colwell (#U11, U16) (4 females, 3 males); Arima Valley, Lower La Laja Trace, 23–24 February 1976, R. K. Colwell (#U12, U13, U15) (9 females, 2 males); ex *Chlorestes notatus notatus* (C. Reichenbach), Andrews Trace, 2 August 1975, R. K. Colwell (#T17) (1 female); Arima Valley, Simla, 30 July–2 August 1975, R. K. Colwell (#T24, T40) (5 females); Lower La Laja Trace, 24 February 1976, R. K. Colwell (#U9) (2 females); Arima Valley, Simla, 18–20 February 1976, R. K. Colwell (#U4, U5) (2 females); ex *Glaucis hirsuta insularum* Hellmayr and Seilern, La Laja Trace, 11 August 1975, R. K. Colwell (#T44) (1 female); Arima Valley, Simla, 24 July 1975, R. K. Colwell (#T50) (6 females); same locality, 15–20 February 1976, R. K. Colwell (#U22, U23, U25, U27, U29, U34, U38, U43, U44, U45, U46, U47) (64 females, 26 males); ex *Phaethornis guy guy* (Lesson), Andrews Trace, 30 December 1973, R. K. Colwell (#T36) (6 females); Arima Valley, Simla, 18 February 1976, R. K. Colwell (#U17) (1 female).

SPECIMEN DEPOSITION.—Voucher specimens are deposited in the following institutions: UMMZ, NMNH, BYU, CNC.

COMMENTS.—Our specimens agree closely with the descriptions given by Fain et al. (1977b) except that the anterior pair of sternal setae in the female are more widely spaced

as in other members of the *kirmsei*-group (26–31 μm vs. 21 μm as given by Fain et al.). Colwell (1986a, 1986b) and Heyneman et al. (1990) have noted the seasonal shift in primary host plants exhibited by this species. The preferred host plant in the wet season is *Hamelia patens*, while *Palicourea crocea* is used preferentially in the dry season. It should be noted that our specimens collected during the wet season averaged slightly larger than specimens taken during the dry season. As the type-series was collected during the dry season, the somewhat larger average measurements given above for the species as a whole are explained by the inclusion of wet-season individuals.

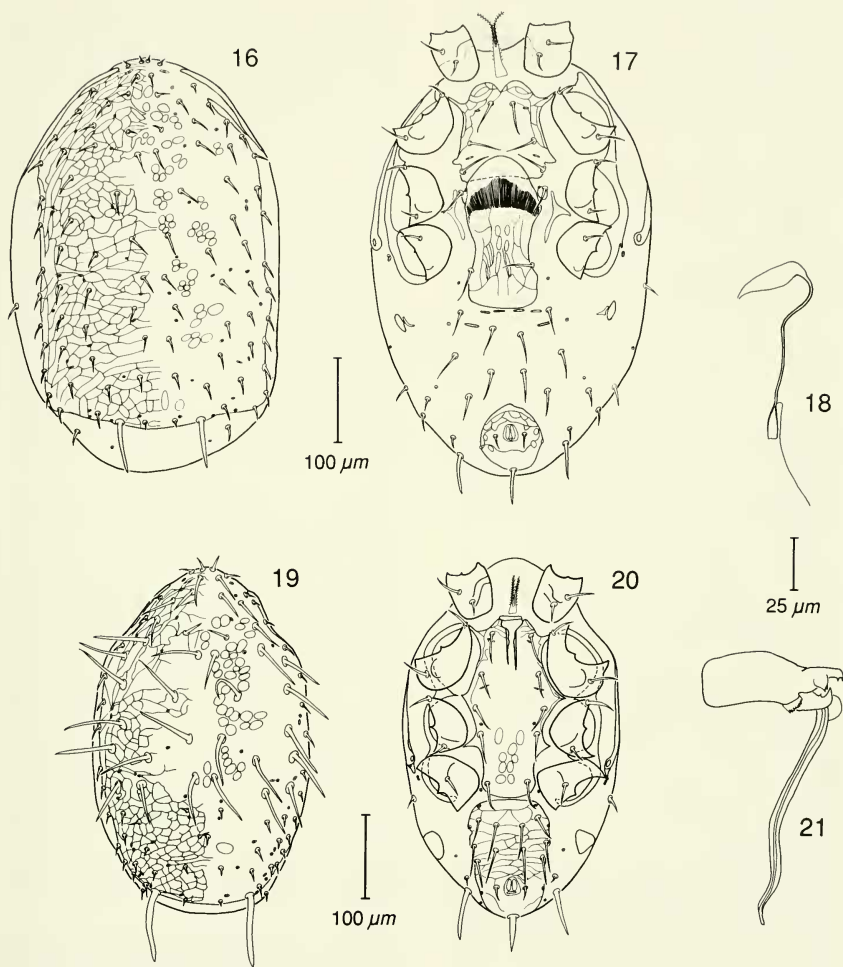
Proctolaelaps jurgatus, new species

Proctolaelaps jurgatus Colwell, 1986: 408, nomen nudum

Proctolaelaps jurgatus Heyneman et al., 1990: 468, nomen nudum

FEMALE (Figs. 16–18).—Idiosomal length 599, 536 (486–631), width 363, 332 (291–383); dorsal shield length 478, 453 (416–485), width 284, 265 (247–285) ($n = 10$). Dorsal shield (Fig. 16) with reticulate pattern over entire surface. Dorsal shield with 44 pairs of smooth, simple setae; marginal setae r2–6 and R1–6 on edge of shield, R7 on membrane posterior to shield, an additional marginal seta (r1) occasionally present unilaterally as on holotype; 3 pairs of submarginal setae (UR) on lateral membrane posteriad of coxae IV. The following measurements of dorsal setae were taken from the holotype, a mite of somewhat larger than average body size: setae j1, j4, and z1 very short (9–11 μm), setae j2–3, z3, s1–2 longer (15–18 μm), other anterior setae longer (22–29 μm); posterior half of shield with anterior median setae J1, Z1, and S1 longer (20–24 μm) than most other setae (15 μm), J5 a microseta (9 μm) and Z5 a stout, elongate spine (64 μm); all marginal setae 15–22 μm long. Glands, proprioceptors, and muscle scars positioned as indicated in Figure 16.

Venter (Fig. 17) with tritosternum with elongate base and slender, tapering, pilose laciniae. Sternal shield longer than wide, with 3 pairs of relatively long setae and 2 pairs of pores, lengths of setae greater than or equal to distance between st2 and st3; anterior lobes and lateral margins of shield with distinct linear pattern. Fourth pair of sternal setae and 3rd pair of sternal pores on metasternal



Figs. 16–21. *Proctolaelaps jurgatus*: 16, female dorsum; 17, female venter; 18, female spermathecal system; 19, male dorsum; 20, male venter; 21, male chelicera.

platelets. Genital shield with linear ornamentation, shield widened behind genital setae. Six small sclerites positioned directly posterior to genital shield. Endopodal apodemes distinct between epigynial shield and coxae III–IV; exopodal sclerites extending from between coxae I–II to behind coxae IV. Two pairs of small, elongate metapodal plates.

Anal shield ovoid, longer than wide (length 87, 81 [74–94], width 77, 73 [65–79] μm), ornamentation confined to anterior two-thirds, postanal seta slender, about twice as long as paraanal setae. Posterior ventral region with 8 pairs of setae (JV1–5, Zv1–3), Jv1 and Jv2 typically longer than other anterior setae, Jv5 stout and 53 μm long in holotype;

posterior submarginal setae (UR) also typically visible ventrally (Fig. 17). Peritreme extending anteriorly to a point between bases of dorsal setae *z1* and *s1*. Spermathecal system consisting of a broad, membranous pouch just inside external opening, connecting with an adductor canal approximately 65–70 μm long; a small, elongate, bell-shaped maturation pouch lies at juncture of adductor canal and the long, thin spermiduct (Fig. 18).

Gnathosoma with tectum variably shaped as in *P. kirmsei*. Chelicera with fixed digit bidentate; movable digit also bidentate with strong distal hook; a large, membranous process bearing 2 distal teeth present on paraxial face. Deutosternum with 7 transverse rows of denticles; anterior 6 rows connected; no rows widened. Rostral setae simple, slender, with internal posterior rostral setae at least twice as long as external posterior rostral setae; capitular setae slender, simple. Corniculi parallel; internal malae very thin, extending to or slightly beyond tip of corniculi. Palps similar to other *Proctolaelaps* species.

Legs I–IV (excluding pretarsi) 81, 72, 73, and 86% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxae II and III with pronounced convex boss, coxa IV with a weaker boss. Setation of genua of legs I, II, III, and IV, respectively, 13-11-9-9, that of tibia: 13-10-8-10; all leg setae setiform to filiform except the following spinelike setae: *ad1*, *ad3*, *pd1*, *pd2* of femur I, *pd2* of femur II, *ad1* of femur III, *ad1* and *ad2* of femur IV; setae *all* and *v* of femur IV are setiform, but elongate, about as long as the segment width.

MALE (Figs. 19–21).—Idiosomal length 420 (391–432), width 271 (252–281) ($n = 10$). Reticulate pattern present laterally on shield and on posterior third; central half of shield with pattern very weak or absent (Fig. 19). Shield with 43–45 pairs of setae, posterior marginal (R) setae varying from 5 to 7 pairs, all on shield; anterior marginal seta *r1* occasionally unilaterally present as on figured specimen. One pair of submarginals (UR1) laterad of coxae IV. Anterior dorsal setae of *j*, *z*, and *s* series all spinelike; the following measurements of dorsal setae are taken from the figured specimen: *j1*–17, *j2* and *j3*–42, *j4*–26, *j5*–57, *j6*–68, *z1*–11, *z2*–35, *z3*–44, *z4*–64, *z5*–57, *z6*–64, *s1*–15, *s2*–20, *s3*–57, *s4*, *s5* and *s6* all 66 μm ; all anterior marginal setae 15–20 μm

long. Posterior dorsal setae *J1*, *Z1*, and *S1* also long. Posterior spines, 68, 64, and 55 μm long; terminal seta *Z5* is a thickened, blunt spine, 92 μm long; other posterior dorsal and marginal setae very short (10–15 μm). Glands, proprioceptors, and muscle scars as shown in Figure 19.

Venter (Fig. 20) with tritosternum with base distinctly shorter than in female. Sternogenital shield with reticulation confined to anteriolateral corners, smooth medially and posteriorly, with 5 pairs of setae and 3 pairs of pores. Metapodal plates triangular to quadrate, much larger than in female. Ventrianal shield relatively narrow, not extending to metapodal plates, reticulated over entire surface, with 5 pairs of ventral setae on shield, *Jv1*–3, *Zv1*–2, in addition to paraanal setae. Three pairs of ventral setae (*Jv4*, *Jv5*, and *Zv3*) on membrane, *Zv3* strongly displaced dorso-laterally. Setae *Jv1*, *Jv2*, *Jv3*, and *Zv2* relatively long and setiform (40–45 μm), *Zv1* setiform and somewhat shorter (29 μm); *Jv4* and *Zv3* short (10–11 μm), and *Jv5* a thick, blunt spine, 60–70 μm long. Paraanal setae approximately half as long as thick, blunt postanal seta (35–45 μm). Peritremes much shorter than in female, extending anteriorly to the vicinity of seta *s1*. Endopodal apodemes fused to sternogenital shield; exopodal sclerites well developed laterad of coxae.

Gnathosoma with tectum simpler than in female, broadly rounded and with few or no teeth. Fixed digit of chelicera with one tooth and a bidentate, membranous process as in female; movable digit unidentate, with long, somewhat sinuous spermatodactyl projecting posteroventrally, 114–125 μm long (Fig. 21). Corniculi shorter and stouter than in female, widely spread basally; other features of gnathosoma as on female.

Legs I–IV (excluding pretarsi) 83, 69, 65, and 92% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxa II with pronounced convex boss, coxa III with a weaker boss, coxa IV without boss. Leg I generally similar to female except some setae of femur distinctly more spinelike. Leg II distinctly thickened, setae *ad1*, *pd2*, and all three ventral setae in the form of thick spines; genu and tibia each with seta *pv* a thick spine; tarsus with setae *av1*–2, *pv1*–2, and *mv* with thickened, bulbous base. Leg III with setation generally similar to female but with tarsal setae *av1*–2, *pv1*–2, and *mv* modified as

on leg II. Leg IV strongly modified; femur enlarged, with ventral apophysis bearing partially fused, spurlike ventral seta, dorsal setae thickened and spinelike especially ad1; genu with ventral seta with bulbous base; tibia with ventral setae av and pv likewise modified; tarsus with seta mv with bulbous base, setae av1 and av2 distinctly longer than pv1 and pv2. Pretarsi relatively long.

ETYMOLOGY.—The specific name *jurgatus* is from the Latin meaning "quarrelsome" and is an adjective.

MATERIAL EXAMINED.—All specimens from host plants were collected from the flowers of *Iserita parviflora* Vahl. (Rubiaceae) from the following Trinidad localities (all examined specimens are considered paratypes): Arima Valley, Cricket Pitch near Temple Village, 12 March 1979, R. K. Colwell (#T280) (holotype and 2 other females, 4 males); same data (#T281) (1 female, 2 males, 1 deutonymph); same locality, 23 February 1979, R. K. Colwell (#T242) (1 female); same data (#T240) (2 females); Arima Valley, Temple Village, 11 August 1975, R. K. Colwell (#T74) (3 females); Waller Field, 22 February 1976, R. K. Colwell (#U66) (1 male); Waller Field, near entrance, 21 March 1979, R. K. Colwell (#T622) (10 females, 5 males, 4 deutonymphs); same data (#T620, T621, T622) (a large series of specimens).

Specimens collected from hummingbirds include the following phoretic hosts: ex *Amazilia tobaci erythronotos* (Lesson), Waller Field, 23 June 1976, P. Feinsinger (#W2, W3, W4) (21 females); ex *Chlorestes notatus notatus* (C. Reichenbach), Lower La Laja Trace, 23 February 1976, R. K. Colwell (#U8) (1 female); ex *Chrysolampis mosquitus* (Linne), Waller Field, 23 June 1976, P. Feinsinger (#W5, W6, W7, W8, W9) (48 females, 5 males); ex *Phaethornis longuemareus longuemareus* (Lesson), Waller Field, 23 June 1976, P. Feinsinger (#W10, W11, W12, W13) (2 females, 2 males).

SPECIMEN DEPOSITION.—Holotype and paratypes in UMMZ, additional paratypes in NMNH, BYU, CNC, and IRSNB.

COMMENTS.—This species is most closely related to *P. kirmsei*, sharing with that species the derived character states of a bell-shaped maturation pouch in the female spermathecal system and the enlarged central setae of the male dorsum. With respect to other members

of the *kirmsei*-group, this species manifests the ancestral conditions of retaining metasternal platelets in the female, retaining dorsal seta z3 in both sexes, having posterior setae z5 and Jv5 simple (not clubbed) spines, and having all marginal setae (except R7) on the dorsal shield.

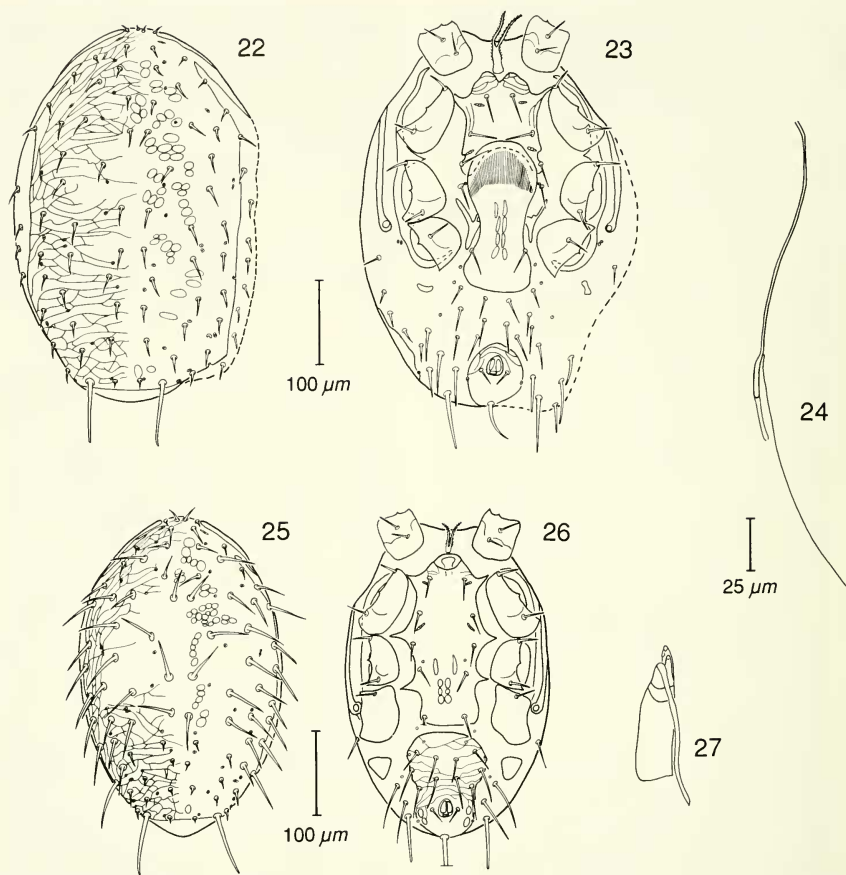
Proctolaelaps jurgatus may be distinguished from *P. kirmsei* in the female by the relatively longer sternal setae, longer maturation pouch in the spermathecal system, and relatively shorter posterior seta Jv5; and in the male by the much greater size of the anterior dorsal setae, especially j1–3, z2–3, and s3.

Proctolaelaps mermillion, new species

Proctolaelaps mermillion Colwell, 1986a: 408, nomen nudum

FEMALE (Figs. 22–24).—The following description is of the holotype and only known female. Idiosomal length 468, width 301 μ m; dorsal shield length 456, width 263 μ m. Dorsal shield (Fig. 22) with reticulate pattern over entire surface. Dorsal shield with 34 pairs of smooth, simple setae; seta z3 absent; marginal setae r2–3 on shield, other anterior marginals (r4–6) and posterior marginals (R1–7) on membrane lateral to shield (R5 unilaterally absent); 3 pairs of submarginal setae (UR) on lateral membrane posteriad of coxae IV. All setae setiform except Z5, which is an elongate, blunt spine. Setal lengths as follows: j1–6, 7, 11, 13, 15, 18, 22 μ m; z1–6 (z3 absent), 7, 20, x, 22, 20, 20 μ m; s1–6, 11, 11, 18, 23, 24, 22 μ m; posterior half of shield with J1–5, 22, 20, 19, 20, 8 μ m; Z1–5, 22, 22, 20, 19, 77 μ m; S1–5, 18, 18, 15, 15, 15 μ m; all marginal setae 13–15 μ m long except R7, which is more spinelike and 33 μ m long. Glands, proprioceptors, and muscle scars positioned as indicated in Figure 22.

Venter (Fig. 23) with tritosternum with elongate base and slender, tapering, pilose laciniae. Sternal shield longer than wide, with distinctly concave posterior border, bearing 3 pairs of setae and 2 pairs of pores; anterior lobes of shield well developed, with distinct linear pattern. Fourth pair of sternal setae and 3rd pair of sternal pores on membrane posterior to shield; metasternal platelets absent. Genital shield without linear ornamentation, shield distinctly widened behind genital setae. No small sclerites observed posterior



Figs. 22–27. *Proctolaelaps mermillon*: 22, female dorsum; 23, female venter; 24, female spermathecal system; 25, male dorsum; 26, male venter; 27, male chelicera.

to genital shield. Endopodal apodemes distinct between epigynial shield and coxae III–IV; exopodal sclerites extending from between coxae I–II to behind coxae IV. One pair of small, elongate metapodal plates. Anal shield ovoid, longer than wide, ornamentation confined to anterior half, postanal seta slender, about twice as long as paraanal setae. Posterior ventral region with 8 pairs of setae (Jv1–5, Zv1–3) and a supernumerary Zv seta unilaterally; lengths of setae as follows: Jv1–5, 26, 35, 35, 46, 68 µm; Zv1–3, 20, 31, 29 µm;

setae setiform to filiform except Jv4–5 and two posterior UR setae, which are thickened spines, the latter being 37 and 48 µm long. Peritreme extending antieriad to a point approximating base of dorsal seta z1. Spermathecal system lacking expanded, membranous pouch inside opening, system consisting of a narrow adductor canal approximately 117 µm long; an elongate maturation pouch 48 µm long, which is divided roughly in half, anterior half more strongly sclerotized; and a thin spermiduct at least 110 µm long (Fig. 24).

Gnathosoma with tectum broadly rounded with few apical teeth. Chelicerae visible only in dorsoventral view, with fixed digit bidentate; movable digit not clearly observed. Deutosternum with 7 transverse rows of denticles; anterior 6 rows connected; no rows widened. Rostral setae simple, slender, with internal posterior rostral setae at least twice as long as external posterior rostral setae; capitular setae slender, simple. Corniculi parallel; internal malae not observed. Palps similar to other *Proctolaelaps* species.

Legs I–IV (excluding pretarsi) 94, 65, 77, and 96% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxae II and III with convex boss, coxa IV with a weaker boss. Setation of genua of legs I, II, III, and IV, respectively, 13-11-9-9, that of tibia: 13-10-8-10; all leg setae setiform to filiform except the following spinelike setae: ad1 of femur III, ad1 and ad2 of femur IV, and v of femur IV, which is strong and about as long as the segment width.

MALE (Figs. 25–27).—The following description is of the single available male specimen. Idiosomal length 386, width 256 μm . Reticulate pattern present on anterior quarter and posterior half and laterally on shield, central region of shield with pattern very weak or absent (Fig. 25). Shield with 41 pairs of setae, z3 absent, only 3 pairs of posterior marginal (R) setae present, all on shield. One pair of submarginals (UR1) laterad of coxae IV. Many dorsal setae elongate and spinelike, lengths of setae: j1–6, 15, 20, 22, 31, 35, 44 μm ; z1–6, 9, 42, x, 44, 45, 48 μm ; s1–6, 11, 11, 45, 48, 53, 48 μm ; posterior setae j1–5, 46, 9, 7, 6, 3 μm ; Z1–5, 48, 13, 9, 9, 70 μm ; S1–5, 44, 44, 34, 24, 11 μm . All marginal setae elongate and spinelike, lengths of r2–6 and R1–3, 33, 51, 44, 53, 44, 48, 48, 57 μm . Glands, proprioceptors, and muscle scars as shown in Figure 25.

Venter (Fig. 26) with tritosternum with base distinctly shorter than in female. Sternogenital shield with very weak reticulation confined to anteriolateral corners, smooth medially and posteriorly, with 5 pairs of setae and 3 pairs of pores. Metapodal plates triangular, much larger than in female. Ventrianal shield relatively narrow, not extending to metapodal plates, reticulated over entire surface, with 5 pairs of ventral setae on shield, Jv1–3, Zv1–2, in addition to paraanal setae. Three pairs of ventral setae (Jv4, Jv5, and Zv3) on

membrane. Setae Jv1–3 and Zv1–3 moderately long and setiform, lengths 33, 40, 41, 24, 42, 53 μm ; Jv4 and Jv5 are stouter and spinelike, 53 and 57 μm long. Paraanal setae thin, postanal seta thick, broken in specimen examined. Peritremes similar to female, extending anteriorly to the vicinity of seta z1. Endopodal apodemes fused to sternogenital shield; exopodal sclerites well developed laterad of coxae, but difficult to observe due to distortion of legs in specimen.

Gnathosoma with tectum similar to female, broadly rounded and with few teeth. Chelicerae only observed in dorsoventral view; fixed digit of chelicera with one tooth; movable digit not clearly observed, with moderately sized, slightly sinuous spermatodactyl projecting posterioventrally, 73 μm long (Fig. 27). Corniculi shorter and stouter than in female, widely spread basally; other features of gnathosoma as on female.

Legs I–IV (excluding pretarsi) 90, 71, 71, and 97% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxa II with pronounced convex boss, coxa III with a weaker boss, coxa IV without boss. Leg I generally similar to female except some setae of femur slightly more spinelike. Leg II distinctly thickened, setae ad1, pd2, and all three ventral setae in the form of thick spines; genu and tibia each with seta pv a thick spine; tarsus with setae av1–2, pv1–2, and mv with thickened, bulbous base. Leg III with setation generally similar to female but with tarsal setae av1–2, pv1–2 and mv modified as on leg II, although setal bases are not as swollen. Leg IV strongly modified; femur enlarged, with ventral apophysis bearing partially fused, spurlike ventral seta, dorsal setae thickened and spinelike especially ad1; genu with ventral seta with bulbous base; tibia with ventral setae av and pv likewise modified; tarsus with seta mv with bulbous base, setae av1 and av2 distinctly longer than pv1 and pv2. Pretarsi relatively long.

ETYMOLOGY.—The species name *mermillion* is modified from the Greek meaning “gladiator.” It is a masculine noun in apposition.

MATERIAL EXAMINED.—Holotype female and 1 paratype male from the nares of *Amazilia chionopectus* (Trochilidae), TRINIDAD: Simla Research Station, 4 mi N Arima, 18 February 1976, R. K. Colwell (#U3).

Two additional female specimens collected from a hummingbird, *Phaethornis guy guy* (Lesson), same locality and date, R. K. Colwell (#U18), were not included in the above description and are not considered paratypes.

SPECIMEN DEPOSITION.—Holotype and paratype in UMMZ.

COMMENTS.—*Proctolaelaps mermillion* is the only species of flower mite we were unable to collect from a host plant in Trinidad. We suspect that the host of this species is an epiphyte because, while our collecting of terrestrial hummingbird-pollinated plants was exhaustive, we were unable to sample some epiphytic species.

This species is most closely related to *P. hunteri*, a species known at present only from Brazil. The two species share the derived character states of loss of dorsal seta z3 in both sexes, posterior marginal setae off the dorsal shield in the female, and the enlargement of the posterior marginal setae in the male. The species differs from *P. hunteri* in the female by the posteriorly concave sternal shield, and by having marginal setae r4–5 off the dorsal shield; male *P. mermillion* lack 4–5 pairs of posterior marginal setae that are present and elongate in *P. hunteri*, and also posterior dorsal setae S3–5 are distinctly shorter in male *P. mermillion*.

Proctolaelaps glaucis Fain, Hyland and Aitken, 1977

Proctolaelaps glaucis Fain, Hyland and Aitken, 1977a: 185

Proctolaelaps glaucis Fain, Hyland and Aitken, 1977b: 129

Proctolaelaps glaucis Colwell, 1985: 61

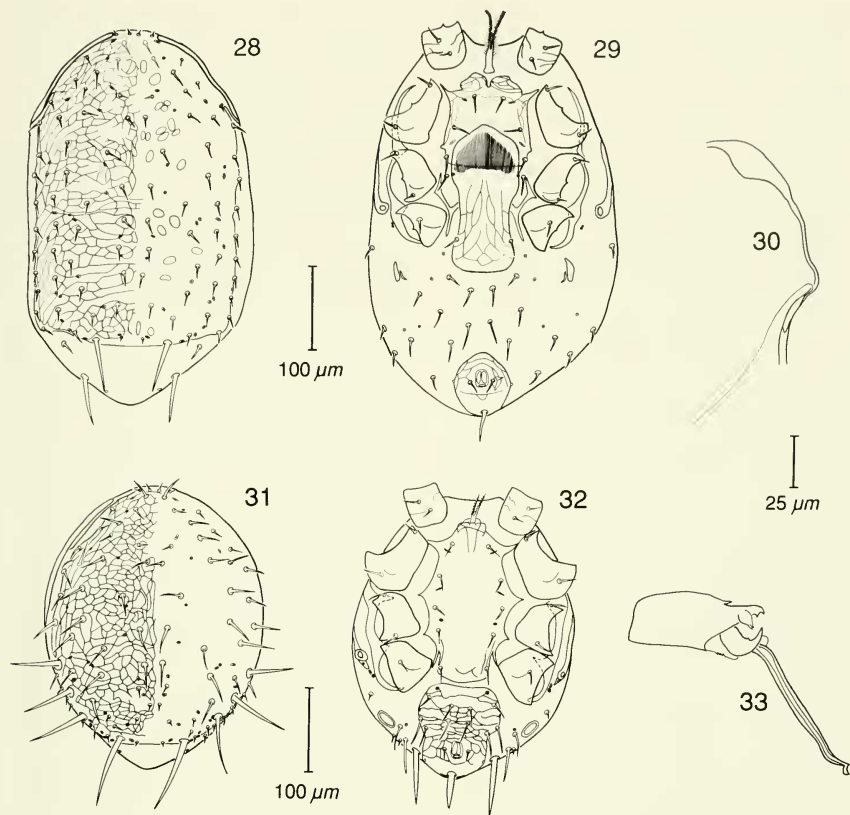
Proctolaelaps glaucis Colwell, 1986a: 408

This species was briefly diagnosed from the holotype female collected from the nares of *Glaucis hirsuta* from "Trinidad" (Fain et al. 1977a). Fain et al. (1977b) provided a more complete description of the female and a brief description of one male; both sexes were figured. All specimens were collected from the nares of *G. hirsuta* from the following Trinidad localities: Ravine Sable Trace–Vega de Oropouche, Esperanza Estate, Corneillac Estate, Fort Read. Some aspects of the ecology and host associations of this species have been discussed by Colwell (1985, 1986a). We give here a redescription of this species based on our collections from Trinidad. Our specimens were compared with the holotype.

FEMALE (Figs. 28–30).—Idiosomal length

462 (439–497), width 318 (281–369) μm ; dorsal shield length 400 (386–410), width 258 (246–287) μm ($n = 8$). Dorsal shield (Fig. 28) with reticulate pattern over entire surface. Dorsal shield with 44 pairs of smooth, simple setae; marginal setae r2–6 and R1–6 on edge of shield, R7 on membrane posterior to shield; 3 pairs of submarginal setae (UR) on lateral membrane posteriad of coxae IV. The following measurements of dorsal setae were taken from the figured specimen, a mite of somewhat larger than average body size: j setae very unequal, lengths of j1–6, 8, 22, 18, 9, 18, 20 μm ; anterior z setae also unequal, lengths of z1–6, 12, 24, 15, 22, 20, 20, 20 μm ; s1–2 both 13 μm , s3–6 all 20–22 μm ; posterior dorsal setae (except J5 and Z5) and all marginal setae (r–R) 18–20 μm , J5 very short (7 μm), Z5 long and spinelike (62 μm). Glands, proprioceptors, and muscle scars positioned as indicated in Figure 28.

Venter (Fig. 29) with tritosternum with elongate base and slender, tapering, pilose laciniae. Sternal shield longer than wide, posterior border generally straight, with 3 pairs of setae and 2 pairs of pores; anterior lobes of shield well developed, with distinct linear pattern; linear pattern also present laterally. Fourth pair of sternal setae and 3rd pair of sternal pores on membrane posterior to shield, metasternal platelets absent. Genital shield with linear ornamentation, shield slightly widened behind genital setae. Without small sclerites posterior to genital shield. Endopodal apodemes distinct between epigynial shield and coxae III–IV; exopodal sclerites extending from between coxae I–II to behind coxae IV. Two pairs of metapodal plates, external plate elongate and much larger than internal plate, which was not observed in all specimens. Anal shield wider than long (averaging 70 μm long to 75 μm wide), ornamentation confined to anterior two-thirds, postanal seta spinelike, about twice as long as paraanal setae. Posterior ventral region with 8 pairs of setae (JV1–5, Zv1–3, figured specimen with supernumerary Zv seta unilaterally), Jv1 and Jv2 typically longer than other anterior setae, Jv5 stout and 60–70 μm long; posterior submarginal setae (UR) also typically visible ventrally (Fig. 29). Peritreme extending anteriorly to a point approximating base of dorsal seta z1. Spermathecal system (Fig. 30) consisting of a



Figs. 28–33. *Proctolaelaps glaucis*: 28, female dorsum; 29, female venter; 30, female spermathecal system; 31, male dorsum; 32, male venter; 33, male chelicera.

broad, membranous pouch just inside external opening, connecting with an adductor canal approximately 51 μm long; an elongate maturation pouch 42 μm long that is divided roughly in half, anterior half more strongly sclerotized; and a thin spermiduct at least 100 μm long.

Gnathosoma with tectum broadly rounded with few apical teeth. Chelicerae visible only in dorsoventral view, with fixed digit bidentate and bearing a large, membranous process with two distal teeth; movable digit not clearly observed. Deutosternum with 7 transverse rows of denticles; anterior 6 rows connected; no rows widened. Rostral setae simple, slen-

der, with internal posterior rostral setae slightly less than twice as long as external posterior rostral setae; capitular setae slender, simple. Corniculi parallel; internal malae not observed. Palps similar to other *Proctolaelaps* species.

Legs I–IV (excluding pretarsi) 91, 71, 72, and 90% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxae II and III with convex boss, coxa IV with a weaker boss. Setation of genua of legs I, II, III, and IV, respectively, 13-11-9-9, that of tibia: 13-10-8-10; all leg setae setiform to filiform except the following spinelike setae: ad1 of femur III, and ad1 of

femur IV; seta v of femur IV longer than other setae but not as long as the segment width.

MALE (Figs. 31–33).—Idiosomal length 347 (316–398), width 257 (222–281) ($n = 10$). Reticulate pattern present covering dorsal shield (Fig. 31). Shield with 43–44 pairs of setae, posterior marginal (R) setae varying from 5 to 7 pairs, all on shield except R7. One pair of submarginals (UR1) laterad of coxae IV. Most anterior and central dorsal setae somewhat elongate and spinelike; posterior setae mostly very short except lateral setae S2–3 and r6 and terminal seta Z5, which are very large spines. Dorsal setae exhibiting more length variation than in other species; the following measurements are from the smallest and largest measured males: j1, 7–9; j2, 20–26; j3, 18–18; j4, 11–15; j5, 24–24; j6, 29–37; z1, 7–9; z2, 24–29; z3, 15–20; z4, 26–31; z5, 29–33; z6, 29–31; s1, 10–15; s2, 11–11; s3, 24–30; s4, 30–33; s5, 31–35; s6, 26–35; r2, 13–15; r3, 22–24; r4, 20–24; r5, 24–26; r6, 35–55; posterior setae: J1, 29–37; J2, 7–11; J3, 6–9; J4, 9–9; J5, 4–5; Z1, 29–37; Z2, 29–33; Z3, 13–11; Z4, 11–11; Z5, 70–92; S1, 26–26; S2, 57–66; S3, 57–75; S4, 10–15; S5, 10–10. Posterior marginal setae all approximately 5–9 μm , except R1, which may be somewhat longer when present. Glands, proprioceptors and muscle scars as shown in Figure 31.

Venter (Fig. 32) with tritosternum base distinctly shorter than in female. Sternogenital shield with slight linear ornamentation confined to posteriolateral corners, smooth anteriorly and medially, with 5 pairs of setae and 3 pairs of pores. Metapodal plates difficult to observe, generally hidden by enlarged femora IV; plates ovoid to quadrate, with possibly thickened margins. Ventrianal shield relatively narrow, not extending to metapodal plates, reticulated over entire surface, with 5 pairs of ventral setae on shield, Jv1–3, Zv1–2, in addition to paraanal setae. Three pairs of ventral setae (Jv4, Jv5, and Zv3) on membrane. Setae Jv2, Jv3, and Zv2 setiform and of moderate length (30–33 μm); Jv1, Zv1 setiform and somewhat shorter (20 μm); Jv4 somewhat thicker and 37 μm long; Jv5 a thick, blunt spine, 50–55 μm long. Paraanal setae approximately one-third as long as very thick, blunt postanal seta (38–44 μm). Peritremes much shorter than in female, extending anteriorly to the vicinity of seta s1. Endopodal apodemes fused to sternogenital

shield; exopodal sclerites well developed laterad of coxae.

Gnathosoma with tectum simpler than in female, broadly rounded and with few or no teeth. Fixed digit of chelicera with one tooth and a bidentate, membranous process as in female; movable digit with a rudimentary tooth, with long, somewhat sinuous spermatodactyl projecting posterioventrally, 88 μm long (no variation); spermatodactyl with a small, apical quadrate process projecting from tip (Fig. 33). Corniculi shorter and stouter than in female, widely spread basally; other features of gnathosoma as on female.

Legs I–IV (excluding pretarsi) 98, 82, 77, and 105% of dorsal shield length. Coxa I with fine linear ornamentation medially and laterally; coxa II with pronounced convex boss, coxae III–IV with a weaker boss. Leg I generally similar to female except some setae of femur slightly more spinelike. Leg II distinctly thickened, setae ad1, pd2, and all three ventral setae in the form of thick spines; genu and tibia each with seta pv a thick spine; tarsus with setae av1–2, pv1–2, and mv with thickened, bulbous base. Leg III with setation generally similar to female but with tarsal setae av1–2 and pv1–2 modified as on leg II. Leg IV strongly modified; femur enlarged, with ventral apophysis bearing partially fused, spurlike ventral seta, dorsal setae thickened and spinelike, especially ad1; genu with ventral seta with bulbous base; tibia with ventral setae av and pv likewise modified; tarsus with seta mv with bulbous base, setae av1 and av2 somewhat longer than pv1 and pv2. Pretarsi relatively short.

MATERIAL EXAMINED.—All specimens from host plants were collected from the flowers of *Centropogon cornutus* (L.) Druce (Lobeliaceae) from the following Trinidad localities: Andrews Trace, 10 mi N Arima, 24 February 1979, R. K. Colwell (#T232) (3 females); same locality, 21 February 1976, R. K. Colwell (#U57) (1 female, 1 male); Blanchicheusse Road, mile 18, 21 February 1976, R. K. Colwell (#U56) (1 female); Blanchicheusse Road, Bridge C2/7, 22 August 1980, D. S. Dobkin (#6, 7, 8) (numerous specimens); Arima Valley, Temple Village, 11 August 1975, R. K. Colwell (#T69) (2 females); Carapo Road, 220 meters E Musica Road, 22 February 1979, R. K. Colwell and D. S. Dobkin (#T234) (5 males); Heights of Guanapo Road,

29 December 1973, R. K. Colwell (#T62) (2 females).

Specimens collected from hummingbirds include the following phoretic hosts: ex *Amazilia chionopectus chionopectus* (Gould), La Laja Trace, 10 August 1975, R. K. Colwell (#T30) (1 female); ex *Glaucis hirsuta insularum* Hellmayr and Seilern, Arima Valley, Simla, 22–30 July 1975, R. K. Colwell (#T21, T46, T49, T50, T51, T52, T53) (27 females); same locality, 18 February 1976, R. K. Colwell (#U22, U34) (10 females, 1 male); Andrews Trace, 30 December 1973, R. K. Colwell (#T29) (7 females); Laja Trace, 8–10 August 1975, R. K. Colwell (#T31, T32, T45) (11 females, 2 males).

SPECIMEN DEPOSITION.—Figured voucher specimens deposited in UMMZ, other specimens in NMNH, BYU, CNC, IRSNB.

COMMENTS.—Our specimens agree well with the species as redescribed by Fain et al. (1977b). However, our interpretation of the posterior lateral chaetotaxy of the male dorsum differs from that presented by the previous authors who had only a single male available for examination. We regard the setae identified by Fain et al. (1977b, Fig. 88) as S1, S2, S3, and S4 as actually r6, S1, S2, and S3, respectively. As the lengths of these setae were used as diagnostic characters in their key ("Setae S3 and S4 much heavier and longer . . . than S2 and S1" [p. 121]), it should be noted that setae S4 are actually very short and S2 are long.

Within the *kirmsei*-group, *P. glaucis* shares the loss of the female metasternal platelets and enlargement of male setae r6, S2, and S3 with *P. hunteri* and *P. mermillion*, conditions we regard as derived. The species retains dorsal setae z3 in both sexes, most marginal setae on the dorsal shield in the female, and relatively short posterior marginal setae in the male, ancestral states which are modified in *P. hunteri* and *P. mermillion*. *P. glaucis* also differs in retaining a completely ornamented male dorsum, an ancestral state in the genus.

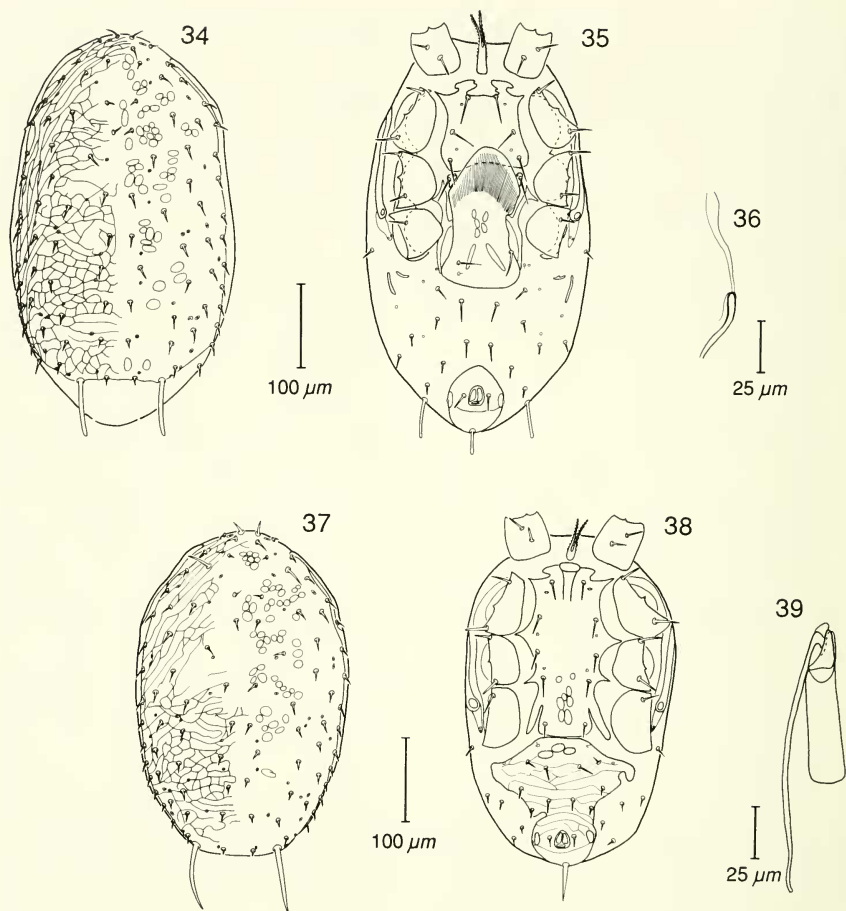
Proctolaelaps rabulatus, new species

Proctolaelaps rabulatus Colwell, 1986a: 408, nomen nudum

FEMALE (Figs. 34–36).—Idiosomal length 486, 480 (456–527), width 287, 301 (257–333) μm ; dorsal shield length 427, 434 (410–456), width 281, 266 (246–287) μm ($n = 10$). Dorsal

shield (Fig. 34) with reticulate pattern over entire surface, more weakly developed anteromedially. Dorsal shield with 43 pairs of smooth, simple setae; anterior seta z3 absent; marginal setae r2–6 and R1–6 on edge of shield, R7 on membrane posterior to shield; only 2 pairs of submarginal setae (UR) on lateral membrane posterior of coxae IV. Dorsal setae relatively short and setiform, lengths very uniform between 14–17 μm except as follows: z1, s1–2, and J5 shorter, 7–9 μm ; j2 and z2 slightly longer, 20–22 μm ; Z5 a large spine, 75 μm , seta appearing slightly clubbed in some specimens. Seta j2 unilaterally absent on holotype. Glands, proprioceptors, and muscle scars positioned as indicated in Figure 28.

Venter (Fig. 35) with tritosternum with elongate base and slender, tapering, pilose laciniae. Sternal shield about as long as wide, anterior border deeply incised medially to level of anterior sternal setae; posterior border slightly concave; shield with 3 pairs of setae and 2 pairs of pores; shield smooth, without linear ornamentation. Fourth pair of sternal setae and 3rd pair of sternal pores on metasternal platelets. Genital shield smooth, without linear ornamentation; genital setae on edges of shield (unilaterally anomalous in holotype, with both genital and paragenital seta well on shield); shield distinctly widened behind genital setae. One pair of very short paragenital setae present lateral to genital shield posterior to level of genital setae. Without small sclerites posterior to genital shield. Endopodal apodemes distinct between epigynial shield and coxae III–IV; exopodal sclerites extending from between coxae I–II to behind coxae IV. Two pairs of metapodal plates, external plate very long and thin and much larger than transverse internal plate. Anal shield distinctly longer than wide, ornamentation very weak behind anus, postanal seta spinelike, appearing slightly clubbed in some specimens, about twice as long as paraanal setae. Posterior ventral region with 8 pairs of short setae (JV1–5, Zv1–3), Jv1 and Jv2 typically longer than other anterior setae, Jv5 stout and slightly clubbed in some specimens, 48 μm long; posterior submarginal setae (UR) also typically visible ventrally (Fig. 35). Peritreme extending anteriorly to a point approximating base of dorsal seta s1. Spermathecal system (Fig. 36)



Figs. 34–39. *Proctolaelaps rabulatus*: 34, female dorsum; 35, female venter; 36, female spermathecal system; 37, male dorsum; 38, male venter; 39, male chelicera.

consisting of a very membranous adductor canal approximately 100 μm long; an elongate maturation pouch 33 μm long, which is undivided; and a short, thin spermiduct, which is difficult to observe.

Gnathosoma with tectum steeply triangular, without teeth. Chelicerae visible only in dorsoventral view, with fixed digit bidentate and bearing a large, membranous process with two distal teeth; movable digit with at least one tooth. Deutosternum with 7 trans-

verse rows of denticles; rows of denticles wider than in other species and not connected by longitudinal grooves laterally. Rostral setae simple, slender, with internal posterior rostral setae slightly less than twice as long as external posterior rostral setae; capitular setae slender, simple. Corniculi parallel; internal malae not observed. Palps similar to other *Proctolaelaps* species.

Legs I–IV (excluding pretarsi) 85, 71, 70, and 93% of dorsal shield length. Coxae

without linear ornamentation or convex bosses. Setation of genua of legs I, II, III, and IV, respectively, 13-11-9-9, that of tibia: 13-10-8-10 (a2 absent unilaterally from genu III in holotype); all leg setae setiform to fili-form except the following spinelike setae: ad1 and pd2 of femur I, ad1 and pd2 of femur II, ad1 of femur III, ad1 and ad2 of femur IV; seta v of femur IV not enlarged.

MALE (Figs. 37-39).—Idiosomal length 410 (392-433), width 253 (240-275) ($n = 4$). Reticulate pattern present covering dorsal shield except in median area on anterior half of shield (Fig. 37). Shield with 43 pairs of setae (z3 absent); most marginal setae normally on shield except R7 on membrane posteroventral to shield. Two pairs of submarginals (UR1) laterad of coxae IV. Dorsal setation essentially similar to female, without enlarged setae (except z2 distinctly longer than others as in female, and spinelike Z5). Glands, proprioceptors, and muscle scars as shown in Figure 37.

Venter (Fig. 38) with tritosternum base distinctly shorter than in female. Sternogenital shield without linear ornamentation, with 5 pairs of setae and 3 pairs of pores. Ventrianal shield widened anteriorly, incorporating metapodal plates, reticulated over entire surface, with 5 pairs of ventral setae on shield, Jv1-3, Zv1-2, in addition to paraanal setae; very short paragenital setae present on anterior edge of shield. Three pairs of ventral setae (Jv4, Jv5, and Zv3) on membrane. All ventral setae short and setiform (including Jv5), Jv1 longest (15 μ m), others 7-10 μ m. Paraanal setae approximately one-third as long as very thick, blunt postanal seta (44 μ m). Peritremes similar to female, extending anteriorly in the vicinity of seta s1. Endopodal apodemes fused to sternogenital shield; exopodal sclerites well developed laterad of coxae.

Gnathosoma with tectum triangular as in female, without teeth. Chelicerae visible only in dorsoventral view, dentition not observable; with long, straight spermatodactyl projecting posteroventrally, 130 μ m long (Fig. 39). Corniculi shorter and stouter than in female, widely spread basally; other features of gnathosoma as on female.

Legs I-IV (excluding pretarsi) 84, 70, 70, and 93% of dorsal shield length. Coxae without linear ornamentation or convex bosses. Leg I generally similar to female except some

setae of femur slightly more spinelike. Leg II distinctly thickened, setae ad1, pd2, and all three ventral setae in the form of thick spines; genu and tibia each with seta pv a thick spine; tarsus with setae av1-2, pv1-2, and mv with thickened, bulbous base, although less modified than in other members of the *kirmsei*-group. Leg III with setation generally similar to female but with tarsal setae av1-2, and pv1-2 modified as on leg II. Leg IV strongly modified; femur enlarged, with ventral apophysis bearing partially fused, spurlike ventral seta, seta uniquely modified, having a very obvious tooth about midway along seta; dorsal femoral setae thickened and spinelike, especially ad1; genu with ventral seta with bulbous base; tibia with ventral setae av and pv likewise modified; tarsal setae generally unmodified. Pretarsi relatively short.

ETYMOLOGY.—The specific name *rabulatus* is from the Latin meaning "brawling."

MATERIAL EXAMINED.—All specimens were collected from the flowers of *Mandevilla hirsuta* (A. Rich.) K. Schum. (Apocynaceae) from the following Trinidad localities: Arima Valley, Temple Village, Cricket Pitch, 17 February 1979, R. K. Colwell (#T225) (holotype and 1 paratype female, 2 paratype males); Waller Field, 25 August 1980, D. S. Dobkin (#65) (5 females, 2 males); same data (#66) (3 females). No specimens are yet known from hummingbird phoretic hosts.

SPECIMEN DEPOSITION.—Holotype female and figured paratype male deposited in UMMZ, other paratypes in NMNH, BYU, CNC.

COMMENTS.—This species shares certain characteristics with *P. mexicanus*, notably the widened deutosternal denticle rows, and the tendency for the large, posterior setae to become clubbed. This latter condition is much more obvious in immatures of *P. rabulatus* than in the adults. These species retain certain ancestral character states suggesting that they may be the sister-group of a clade containing the remaining species in the group. These include the lack of modification of the male dorsal setation and the widened ventrianal shield of the male (more so in *P. rabulatus* than in *P. mexicanus*). *P. rabulatus* may be readily distinguished from *P. mexicanus* by possession of derived states including: in both sexes presence of paragenital setae and absence of dorsal seta z3, and in the male by

the short form of seta Jv5 and the toothed ventral seta of femur IV. *P. rabulatus* retains the ancestral states of most marginal setae on the dorsal shield and metasternal platelets present in the female.

The Proctolaelaps belemensis group.

We group the remaining New World flower-inhabiting *Proctolaelaps* as the "*belemensis*-group." Fain et al. (1977a, 1977b) described *P. belemensis* from numerous species of hummingbirds from Brazil, Panama, Venezuela, and Trinidad. They noted that this species "differs markedly" (p. 133) from the other flower-associated *Proctolaelaps* and listed a set of character states that we regard as a combination of ancestral and derived conditions. Two additional taxa, *P. cyanocompsae* (new status) and *P. spiralis*, share the derived character states that diagnose this group. These species share the hypothetically apomorphic character states of enlargement of dorsal setae j1 in both sexes and the strongly tapered epigynial plate in the female. These species are otherwise rather more plesiomorphic than species in the *kirmsei*-group. Both sexes retain expanded posterior rows of deutosternal teeth and more strongly developed ornamentation on the ventral sclerites. Also males have a broad ventrianal sclerite and simple setae on the legs, and the enlarged seta v of femur IV retains a movable articulation and is not borne on a cuticular tubercle.

During our initial work in Trinidad, we identified mites exhibiting these characteristics from many host plants as *P. belemensis* (e.g., Colwell 1979). Closer examination of morphology, behavior, and host associations allowed us to distinguish four distinct forms that differ primarily in body size, lengths of posterior and marginal setae, and male spermatodactyl morphology. Because these forms exhibit distinct host plant preferences, and no morphological intermediates were discovered, we regard them as separate species. Similarly, because two of these new species are more similar to the previously named "subspecies" *cyanocompsae* than to the nominate subspecies, we give full specific status to the former. Because the morphological differences among these species are relatively minor compared with species in the *kirmsei*-group, a cautionary note is in order. Downes (1990) demonstrated that development in dif-

ferent freshwater mussel hosts can significantly affect the morphology of unionicolid water mites to the extent that offspring of a single female raised on different hosts can exhibit adult morphologies of more than one previously recognized "species." Such host effects could certainly account for character differences such as body size exhibited by the *belemensis*-group species described below. On the other hand, these species are also easily distinguished by male spermatodactyl morphology, a genitalic character that is perhaps less prone to influence by host plant morphology (Eberhard 1985). Experimental transfers of juvenile flower mites to other host plants or study of characters not influenced by host plant morphology or chemistry such as allozymes or nucleic acid sequences will provide the test for the hypothesis that our collections represent distinct species.

The four species of the *belemensis*-group collected in Trinidad are very similar. So, in order to conserve space, a full description is given only for *P. belemensis*. The new species are diagnosed with reference to that species, *P. cyanocompsae*, and each other.

Specimens referable to the *belemensis*-group were collected in the Arima Valley and at Waller Field, Trinidad, from 4 species of hummingbirds (1973–1976): *Chlorestes notatus notatus* (C. Reichenbach) (1 female on 1 bird), *Glaucis hirsuta insularum* Hellmayr and Seilern (60 females and 9 males on 25 birds), *Phaethornis guy guy* (Lesson) (13 females and 1 male on 5 birds), *Phaethornis longuemareus longuemareus* (Lesson) (5 females on 2 birds). These specimens will not be listed separately after the species accounts because they had not yet been identified to the species level at the time of this writing.

Proctolaelaps belemensis Fain, Hyland and Aitken, 1977

Proctolaelaps belemensis Fain, Hyland and Aitken, 1977a: 185

Proctolaelaps belemensis Fain, Hyland and Aitken, 1977b: 133

Proctolaelaps belemensis Hyland, Fain and Moorhouse, 1978: 263

Proctolaelaps belemensis Colwell, 1986a: 408

NOT *Proctolaelaps belemensis* Colwell, 1979: 463

This species was briefly diagnosed from female and male specimens collected from the nares of *Threnetes leucurus* from Belem, Brazil (Fain et al. 1977a). A more complete description, figures of both sexes, and new host and locality records were given later

(Fain et al. 1977b). The latter authors listed *Campylopterus largipennis*, *Phaethornis superciliosus*, and *Glaucis hirsuta* as additional hummingbird hosts and recorded the species from additional localities in Brazil, Panama, Venezuela, and two localities in Trinidad: Cumuto and Ravine Sable Trace, Vega de Oropouche. Hyland et al. (1978) recorded the species from Mexico from *P. superciliosus* and *Campylopterus hemileucurus*. In the published descriptions, measurements were given only for the holotype female and one male specimen. Because only a single male and female attributable to this species were collected during our studies, we include in the following redescription some data taken from two female paratypes and one female from the Mexican collection reported by Hyland et al. (1978).

FEMALE (Figs. 40–44).—Idiosomal length of Trinidad specimen 591, in other specimens examined length range (573–620) μm , width 468 (421–439); dorsal shield length 521 (538–565), width 380 (392–404) μm . Dorsal shield (Fig. 40) with transverse, linear pattern over entire surface, reticulations largely confined to posterior edge and median area. Dorsal shield with 44 pairs of smooth, simple setae; marginal setae r2–6 and R1–6 on edge of shield, R7 on membrane posterior to shield; 3 pairs of submarginal setae (UR) on lateral membrane posterior of coxae IV. The following measurements of dorsal setae were taken from the figured Trinidadian specimen: j1 a stout spine, 44 μm long; j2, z1, s1, and J5 shorter than other dorsal setae, about 13–15 μm (J5 unilaterally absent); most other dorsal setae subequal, 20–24 μm , Z5 a stout spine, 88 μm ; most marginal setae similar in length to dorsal setae, r3 and R7 longer than others, both 33 μm . Glands, proprioceptors, and muscle scars positioned as indicated in Figure 40.

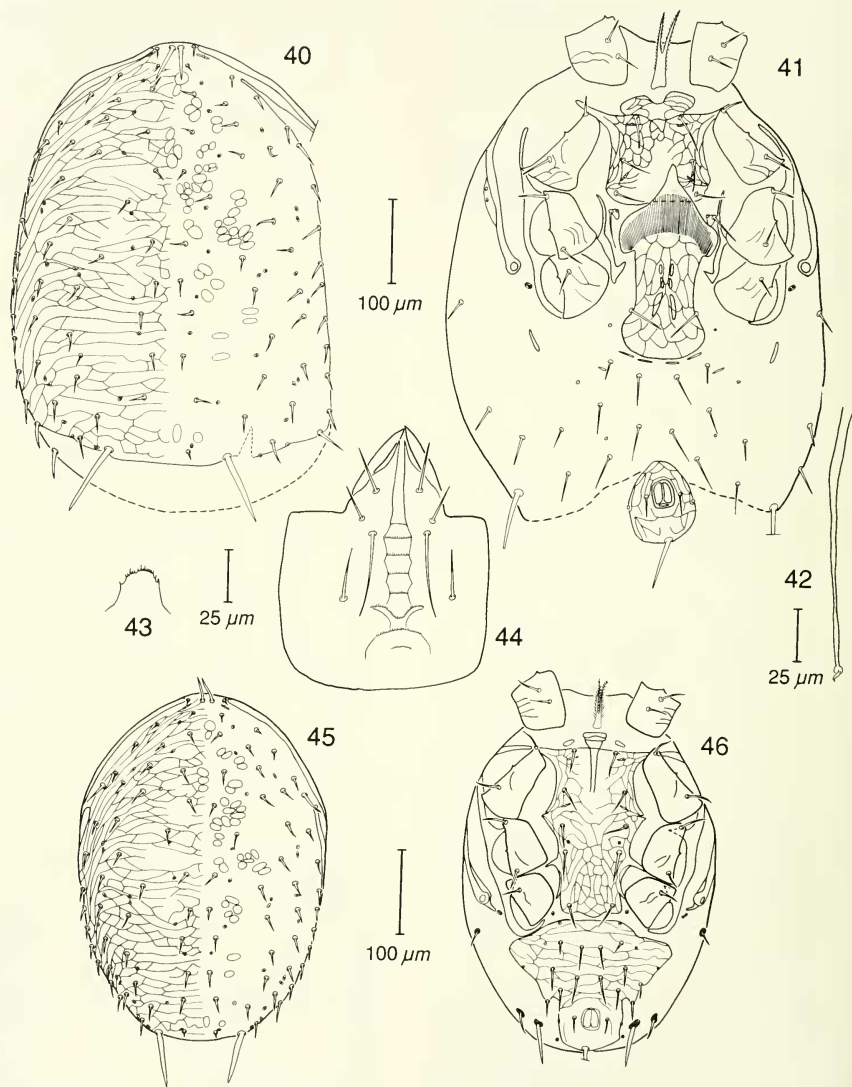
Venter (Fig. 41) with tritosternum with elongate base and slender, tapering, pilose laciniae. Sternal shield longer than wide, posterior border generally straight, with 3 pairs of setae and 2 pairs of pores; anterior lobes of shield very weakly sclerotized, but with distinct linear pattern; reticulate pattern also present over most of shield except central and posterior areas. Fourth pair of sternal setae and 3rd pair of sternal pores on metasternal platelets. Genital shield with reticulate orna-

mentation, shield distinctly widened behind genital setae. With 6 small transverse sclerites posterior to genital shield. Endopodal apodemes distinct between epigynial shield and coxae III–IV; exopodal sclerites extending from middle of coxae II to behind coxae IV. One pair of elongate metapodal plates. Anal shield longer than wide, reticulate ornamentation covering most of shield; postanal seta spinelike, at least twice as long as paraanal setae. Posterior ventral region with 7 pairs of filiform setae (JV1–4, Zv1–3), Jv5 a stout spine; lengths of Jv1–5, 40, 46, 44, 37, 75 μm , Zv1–3, 22, 44, 26 μm . Posterior submarginal setae (UR) also typically visible ventrally (Fig. 41). Peritreme extending anteriorly to a point approximating base of dorsal seta z1. Spermathecal system (Fig. 42) simple, consisting of an adductor canal wider nearer to external opening, approximately 132 μm long; a very short, bulbous maturation pouch at inner terminus of canal; and a very short, hooked spermiduct.

Gnathosoma with tectum rounded and strongly toothed (Fig. 43). Chelicerae visible only in dorsoventral view, with fixed digit bearing a row of small teeth along the length of the digit and a large, membranous antiaxial process with two distal teeth; movable digit not clearly observed. Subcapitulum (Fig. 44) with deutosternum having 7 rows of denticles; anterior 6 rows connected; 5th and 6th rows widened. Rostral setae simple, slender, with internal posterior rostral setae more than twice as long as external posterior rostral setae; capitular setae slender, simple. Corniculi convergent; internal malae not observed. Palps similar to other *Proctolaelaps* species.

Legs I–IV (excluding pretarsi) 110, 87, 76, and 109% of dorsal shield length. All coxae with transverse lines ventrally, without bosses. Setation of genua of legs I, II, III, and IV, respectively, 13-11-9-9, that of tibia: 13-10-8-10; all leg setae setiform to filiform, tarsal setae especially long; without spinelike setae.

MALE (Figs. 45–46).—Redescription based on single Trinidadian male. Idiosomal length 430 μm , width 316 μm . Reticulate pattern present covering dorsal shield (Fig. 45). Shield with 44 pairs of setae, all marginal setae on shield except R7. One pair of submarginals (UR1) laterad of coxae IV. Relative lengths of dorsal setae as in female; j1-33, r3-29, R7-26,



Figs. 40–46. *Proctolaelaps belemensis*: 40, female dorsum; 41, female venter; 42, female spermathecal system; 43, female tectum; 44, female subcapitulum; 45, male dorsum; 46, male venter.

Z5-62 μm ; most other dorsal setae 11–15 μm . Glands, proprioceptors and muscle scars as shown in Figure 45.

Venter (Fig. 46) with tritosternum shorter than in female. A pair of small, pre-endopodal sclerites adjacent to genital opening. Sternogenital shield with reticulate pattern well developed over entire shield except anterior-medially, with 5 pairs of setae and 3 pairs of pores. Ventrianal shield widened anteriorly, incorporating metapodal plates, reticulated over entire surface, with 7 pairs of ventral setae on shield, Jv1–4, Zv1–3, in addition to paraanal setae; thickened seta Jv5 on membrane; other setae filiform, relative lengths as in female. The unilateral absence of Zv3 and the position of Jv4 on small extensions of the ventrianal plate are interpreted here as anomalies. Jv4 is off the plate in the "allotype" described for this species, as well as in all other species of the *belemensis*-group. Paraanal setae relatively short, blunt postanal seta broken. Peritremes as in female, extending anteriorly to the vicinity of seta z1. Endopodal apodemes fused to sternogenital shield; exopodal sclerites well developed laterad of coxae.

Gnathosoma with tectum as in female, broadly triangular and toothed. Chelicerae only visible in dorsoventral view. Cheliceral digits similar to female; spermatodactyl essentially straight, projecting posterioventrally, 140 μm long; other features of gnathosoma as on female.

Legs I–IV (excluding pretarsi) 118, 88, 79, and 114% of dorsal shield length. Coxae with linear ornamentation as in female. Legs generally similar to female except some setae shorter and more spinelike; these include av1 of femur I, av1 of femur II, av and pv of genu II, and pv of genu III. Ventral seta of femur IV enlarged, but with movable articulation. Pretarsi all elongate.

MATERIAL EXAMINED.—In addition to two paratypes from the type locality in Brazil kindly provided by Dr. Fain, we have examined one of the Mexican specimens reported by Hyland et al. (1978) and the following specimens from Trinidad: from flowers of *Monotagma spicatum* (Aubl.) Macbr. (Marantaceae), La Laja Trace, 8 mi N Arima, 17 February 1976, R. K. Colwell (#U64) (figured female and male).

SPECIMEN DEPOSITION.—Figured voucher specimens deposited in UMMZ.

COMMENTS.—Our specimens generally agree with the published description and figures. The presence of setae Jv4 on the ventrianal shield of the male is regarded as an anomaly in our specimen. This species is one of two relatively small species in the group. Differences between this species and the other small species, *P. contumex*, are discussed below.

We believe it is unlikely that *Monotagma spicatum* is the true host plant of *P. belemensis* for two reasons. First, although more than a hundred flowers of this plant were examined, only two specimens of *P. belemensis* were found. Second, the phoretic hosts from which *P. belemensis* has been collected elsewhere (*Glaucis hirsuta*, *Threnetes leucurus*, *Phaethornis superciliosus*, *Campylopterus largipennis*, and *C. hemileucurus* [Fain et al. 1977a, 1977b, Hyland et al. 1978]) all have long bills (3.2, 3.2, 3.8, 3.8, and 3.3 cm, respectively), whereas the flowers of *Monotagma spicatum* are less than 2 cm in length. In general, hummingbirds feed on flowers that approximate their bill length (Feinsinger and Colwell 1978). The true host plant (or plants) of *P. belemensis* thus, almost surely, has flowers more than 3 cm in length.

Proctolaelaps contumex, new species

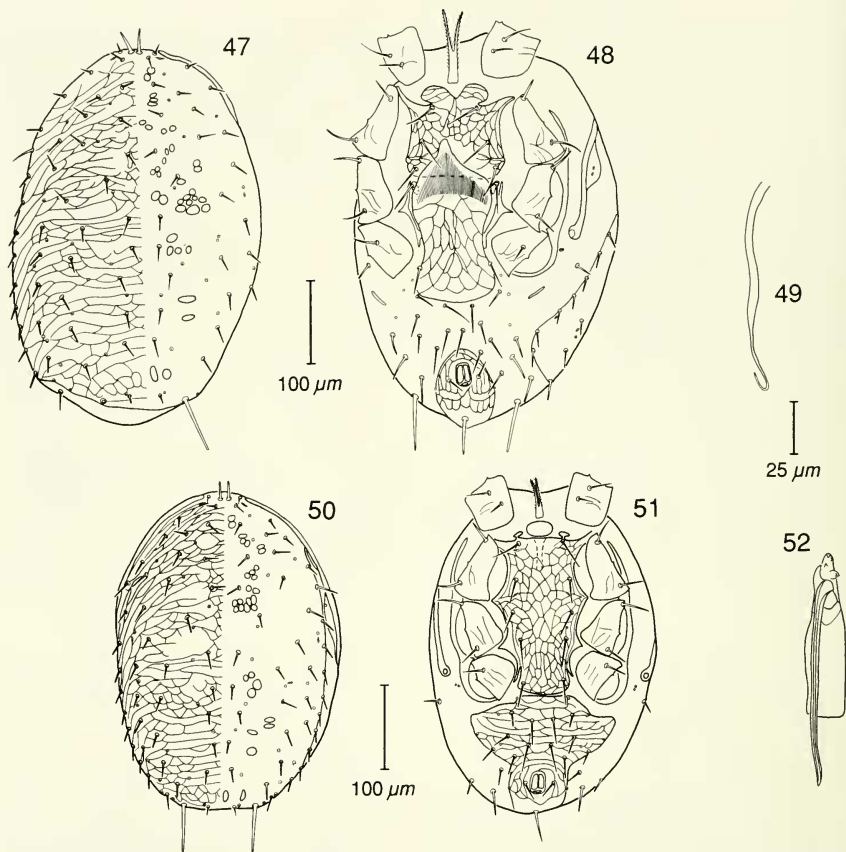
Proctolaelaps belemensis Colwell, 1979: 463, NOT *P. belemensis* Fain, Hyland and Aitken, 1977

Proctolaelaps contumex Colwell, 1986a: 408, nomen nudum

DIAGNOSIS.—This species is very similar to *P. belemensis*. Females (Figs. 47–49) differ primarily in the distinctly smaller body size (idiosomal length of holotype and paratype, 468–538 μm , width 328–363 μm ; dorsal shield length 450–456, width 322–328 μm), and the form of the spermathecal system, which consists of a long, simple tube that is thickened towards the exterior and tapers to a fine point, entire tube 123 μm long (Fig. 49). Body setae proportioned as in *P. belemensis*, but setae absolutely shorter.

MALE (Figs. 50–52).—Similar to *P. belemensis* but smaller, both specimens with idiosomal length 410 μm , width 254–281 μm . Spermatodactyl (Fig. 52) much shorter than in *P. belemensis*, length 100–105 μm . Most body setae proportioned as in *P. belemensis*, but setae absolutely shorter; posterior ventral seta Jv5 only slightly enlarged, 33 μm long.

ETYMOLOGY.—The specific name *contumex* is modified from the Latin *contumax*, meaning "defiant" and is an adjective.



Figs. 47–52. *Proctolaelaps contumex*: 47, female dorsum; 48, female venter; 49, female spermathecal system; 50, male dorsum; 51, male venter; 52, male chelicera.

MATERIAL EXAMINED.—All specimens were collected from flowers of *Cephaelis muscosa* Sw. (Rubiaceae) as follows: Blanchisseuse Road, mile 19, 13 March 1979, R. K. Colwell (#T275) (holotype and one other female, 1 male, 1 larva); Arima Valley, Temple Village, Cricket Pitch, 16 February 1979, R. K. Colwell (#T201) (1 male).

SPECIMEN DEPOSITION.—Holotype female and 1 paratype male in UMMZ, other paratypes in BYU.

Proctolaelaps certator, new species

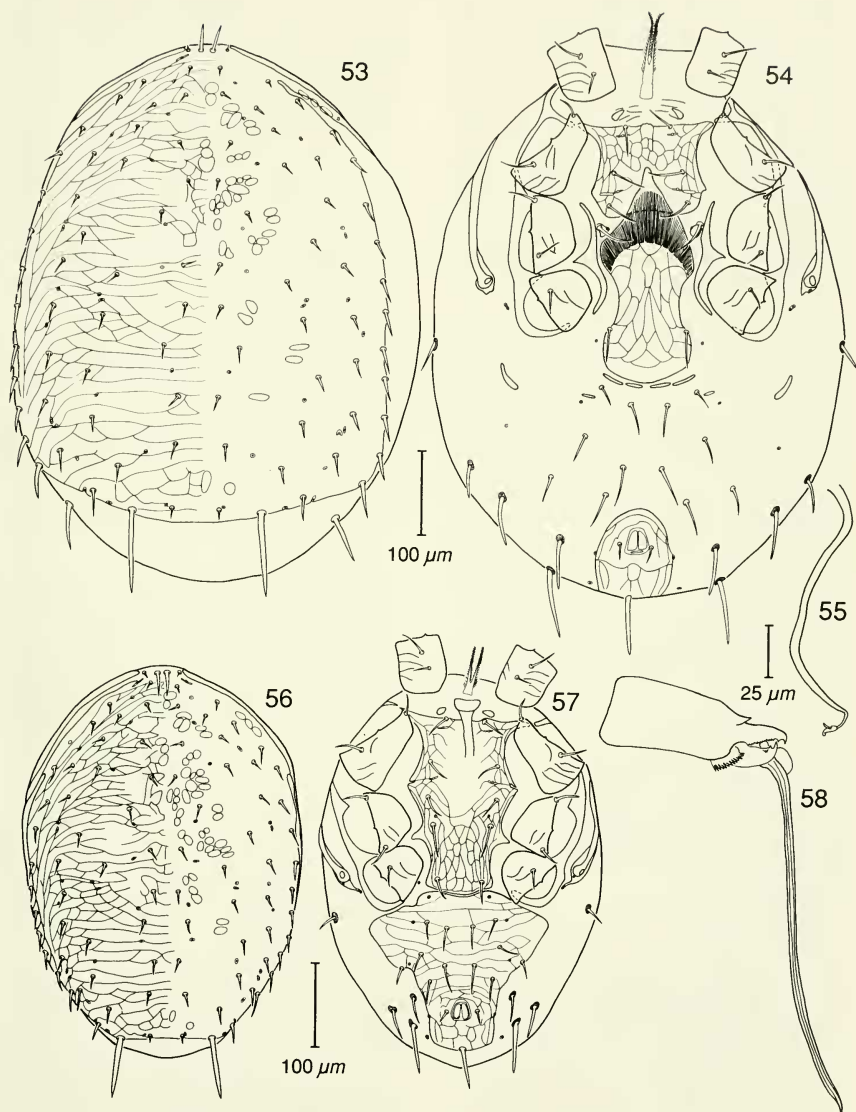
Proctolaelaps certator Dobkin, 1985: 536, nomen nudum

Proctolaelaps certator Colwell, 1986a: 408, nomen nudum

Proctolaelaps certator Colwell, 1986b: 491, nomen nudum

Proctolaelaps certator Heyneman et al., 1990: 468, nomen nudum

FEMALE (Figs. 53–55).—Idiosomal length 620, 659 (556–702), width 468, 496 (445–527) μm ; dorsal shield length 573, 562 (544–585), width 450, 430 (404–450) μm ($n = 10$). Dorsal shield (Fig. 53) with transverse, linear pattern over entire surface, reticulations largely confined to median area. Dorsal shield with 44 pairs of smooth, simple setae; marginal



Figs. 53–58. *Proctolaelaps certator*: 53, female dorsum; 54, female venter; 55, female spermathecal system; 56, male dorsum; 57, male venter; 58, male chelicera.

setae r2-6 and R1-6 on edge of shield, R7 on membrane posterior to shield; 3 pairs of submarginal setae (UR) on lateral membrane posterior of coxae IV. The following measurements of dorsal setae were taken from the holotype: j1 a stout spine, 33 μm long; j2, z1, s1, and J5 shorter than other dorsal setae, about 8-11 μm ; most other dorsal setae subequal, 13-15 μm , Z5 a stout spine, 106 μm ; marginal setae longer than most dorsal setae, gradually increasing in length from anterior to posterior, r3 (24 μm) only slightly longer than r2 (22 μm); R7 longer than others (59 μm). Glands, proprioceptors, and muscle scars positioned as indicated in Figure 53.

Venter (Fig. 54) very similar to *P. belemensis* except region of sternal shield anterior to first sternal setae lineate and with a pair of distinct pre-endopodal sclerites; genital shield more elongate and tapering anteriorly. Posterior ventral setae Jv4 and Jv5 elongate and spinelike, 63 and 88 μm long. Spermathecal system (Fig. 55) simple, consisting of an adductor canal wider nearer to external opening, approximately 145 μm long; a very short, bulbous maturation pouch at inner terminus of canal; and a very short, hooked spermiduct. Gnathosoma and legs as in *P. belemensis*.

MALE (Figs. 56-58).—Idiosomal length 500 (486-509), width 320 (313-351) μm ($n = 10$). Linear-reticulate pattern covering dorsal shield (Fig. 56). Shield with 44 pairs of setae, all marginal setae on shield except R7. One pair of submarginals (UR1) laterad of coxae IV. Relative lengths of dorsal setae as in female; j1-35, r3-29, R7-41, Z5-78 μm ; most other dorsal setae 13-18 μm . Glands, proprioceptors, and muscle scars as shown in Figure 56.

Venter (Fig. 57) with tritosternum shorter than in female. A pair of small presternal sclerites adjacent to genital opening. Sternogenital shield with reticulate pattern well developed over entire shield except anteromedially, with 5 pairs of setae and 3 pairs of pores. Ventrianal shield widened anteriorly, incorporating metapodal plates, reticulated over entire surface, with 6 pairs of ventral setae on shield, Jv1-3, Zv1-3, in addition to paraanal setae; setae Jv4-5 on membrane; Jv5 a thickened spine, 64 μm long; other setae filiform, relative lengths as in female. Paraanal setae relatively short (22 μm), postanal seta a thickened spine 51 μm long.

Peritremes as in female, extending anterior to the vicinity of seta z1. Endopodal apodemes fused to sternogenital shield; exopodal sclerites well developed laterad of coxae.

Gnathosoma with tectum as in female, broadly triangular and strongly toothed. Chelicerae with fixed digit with a large, subapical tooth and a row of fine teeth, membranous, bidentate process on paraxial surface; movable digit strongly hooked, with a subapical tooth. Arthrodial membrane at base of movable digit strongly fimbriate. Spermatodactyl slightly curving distally, projecting posteriorly, 180-185 μm long; other features of gnathosoma as on female.

Legs I-IV (excluding pretarsi) 108, 81, 82, and 106% of dorsal shield length. Coxae with linear ornamentation as in female. Legs generally similar to female except some setae shorter and more spinelike; these include av1 of femur I, av1 of femur II, av and pv of genu II, and pv of genu III. Ventral seta of femur IV enlarged, but with movable articulation. Pretarsi all elongate.

ETYMOLOGY.—The specific name *certator* is from the Latin meaning "disputant" and is a masculine noun in apposition.

MATERIAL EXAMINED.—Holotype female from flowers of *Heliconia bihai* L. (Musaceae), Andrews Trace, 10 mi N Arima, 21 February 1976, R. K. Colwell (#U60) (holotype and 3 paratype females); the following collections also from *H. bihai* (all paratypes): Simla Research Station, 4 mi N Arima, 15 February 1976, R. K. Colwell (#U59) (1 female, figured and 1 other male); same locality, March 1980, D. S. Dobkin (#9) (4 females); same data (#18) (2 females); same data (#26) (2 females, 6 males); same data (#28) (3 females, 2 males); same data (#45) (2 females, 3 males); Waller Field, 22 February 1976, R. K. Colwell (#U63) (1 female, 1 male).

The following collections from flowers of *Heliconia tortuosa* Griggs (Musaceae): Temple Village, Davis Home Road, 11 March, 1980; D. S. Dobkin (#T533) (2 females, 2 males); Simla Research Station, March 1980, D. S. Dobkin (#53) (1 female).

The following specimens from flowers of *Aechmea fendleri* Andre (Bromeliaceae): top of Arima Valley, Textel Road, 1 March 1979, R. K. Colwell (#T252) (3 females).

The following specimens from flowers of *Costus scaber* Ruiz & Pavón (Zingiberaceae):

Andrews Trace, 10 mi N Arima, 1 August 1975, R. K. Colwell (#T7) (4 females); La Laja Trace, 8 mi N Arima, 23 February 1976, R. K. Colwell (#U33) (2 females, 1 male); near Simla Research Station, 4 mi N Arima, 11 June 1976, P. Feinsinger (#W16) (6 females); same locality, 12 August 1975, R. K. Colwell (#T59) (2 females).

SPECIMEN DEPOSITION.—Holotype and paratypes in UMMZ, other paratypes in BYU, NMNH, CNC, IRSNB.

COMMENTS.—One of four relatively large species in the *belemensis*-group, this species is very similar if not identical to *P. cyano-compae*. The latter species was only diagnosed with reference to *P. belemensis*; the character states listed as diagnostic also occur in *P. certator* and *P. contentiosus* (see below). The only measurements given for *P. cyano-compae* were idiosomal length and width, and these values fall within the range of *P. certator* as described above. We were unable to examine the holotype of *P. cyano-compae*, and until this specimen or additional material from the type-locality can be described in better detail, or males are discovered, the relationship between *P. cyano-compae* and *P. certator* cannot be resolved with certainty.

Proctolaelaps contentiosus, new species

Proctolaelaps contentiosus Colwell, 1986: 408, nomen nudum

Proctolaelaps contentiosus Heyneman et al., 1990: 467, nomen nudum.

DIAGNOSIS.—This species is very similar to *P. certator*. Females (Figs. 59–61) differ primarily in the distinctly larger body size (idiosomal length 702, 726, [684–784], width 486, 516 [468–626] μm ; dorsal shield length 626, 621 [585–644], width 468, 469 [427–486] μm [$n = 10$]), the greater length of anterior marginal seta r_3 compared with other anterior marginal setae (r_3 1.25–1.5 times the length of r_2 and r_4), and the greater length of posterior ventral seta Jv_5 (1.7 times the length of Jv_4 , vs. 1.2–1.4 in *P. certator*).

MALE (Figs. 62–64).—Similar to *P. certator* but larger, idiosomal length 534 (527–544), width 361 (331–392) μm ($n = 4$). Anterior marginal seta r_3 enlarged as in female; posterior ventral region with setae Zv_3 usually absent (unilaterally present in 1 of 4 specimens, absent in all others); posterior ventral seta Jv_4 shorter than Jv_2 . Spermatodactyl

(Fig. 64) distinctly shorter than in *P. certator*, length 160–165 μm .

ETYMOLOGY.—The specific name *contentiosus* is from the Latin meaning “given to combat.”

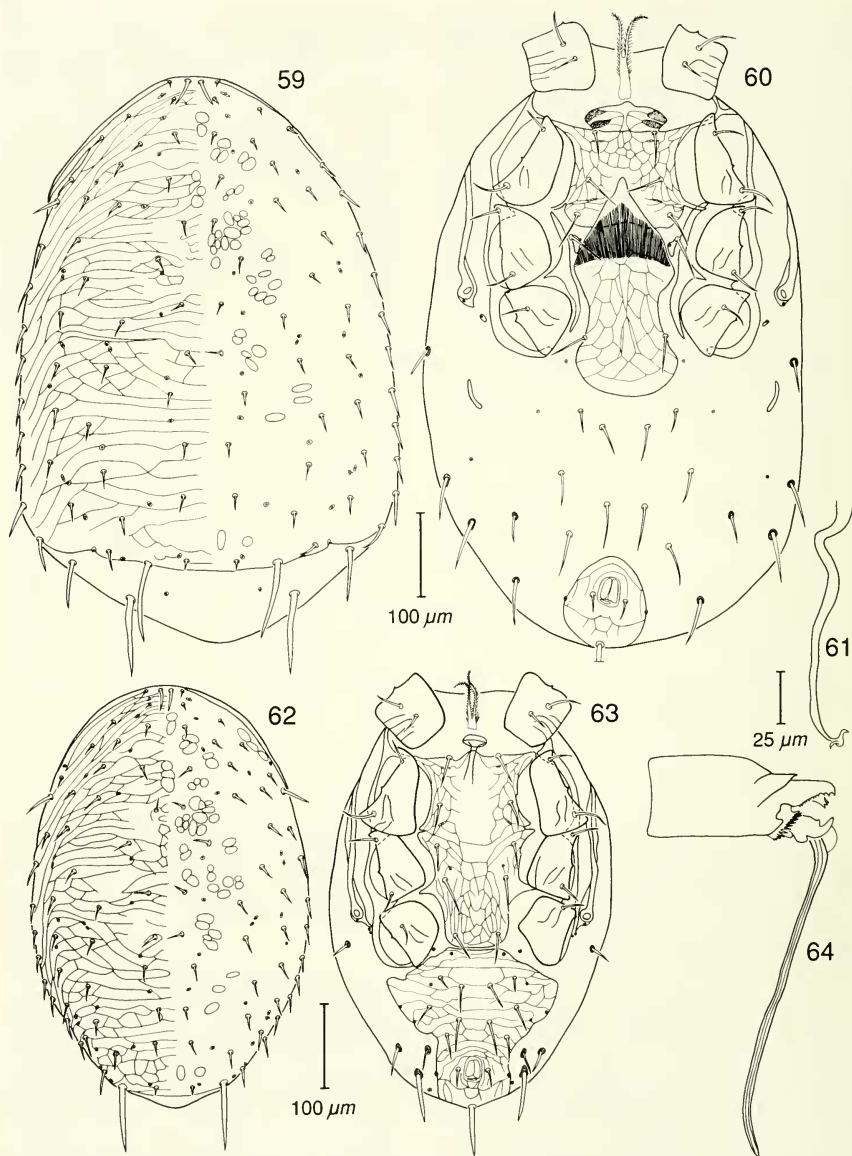
MATERIAL EXAMINED.—All specimens were collected from flowers of *Rencaalmia exaltata* L. f. (Zingiberaceae) as follows: La Laja Trace, 8 mi N Arima, 8 August 1975, R. K. Colwell (#T55) (holotype and one other female, 2 males); same locality, 5 August 1975, R. K. Colwell (#T16) (6 females); same locality, 23 February 1976, R. K. Colwell (#U52) (figured male); La Laja Plantation, 2 March 1979, R. K. Colwell (#T258) (2 females, 2 males).

SPECIMEN DEPOSITION.—Holotype and paratypes in UMMZ, other paratypes in BYU, USNM, CNC.

COMMENTS.—*Proctolaelaps contentiosus* is the largest species now known in the *belemensis*-group. It may be distinguished from *P. certator* by the different length proportions described above. It is interesting to note that although males are absolutely larger than in *P. certator*, the spermatodactyl length is distinctly shorter in *P. contentiosus*. We have found spermatodactyl length in species of the *belemensis*-group to show little within-species variation, but differences between species are marked.

Key to the Species of Flower-inhabiting *Proctolaelaps* in Trinidad

- Both sexes with dorsal setae j_1 stout and spine-like, 2.5–3 times longer than setae j_2 ; female with anterior edge of genital plate strongly tapering; male with spinelike ventral seta of femur IV articulating directly with segment, not on an enlarged process; male leg setae otherwise simple, without expanded, bulbous bases *belemensis*-group 6
- Both sexes with dorsal setae j_1 similar in length to setae j_2 , rarely somewhat enlarged (*P. rabulatus*); female with anterior edge of genital plate broadly rounded; male with spinelike ventral seta of femur IV fused to an enlarged process of the segment; male with some ventral setae of tarsus II, genu and tibia IV with expanded, bulbous bases *kirmsei*-group 2
- Female with anterior lobes of sternal shield narrowly connected to shield; anterior lobes without linear pattern; female with a pair of very small paragenital setae off shield laterad of genital setae; male with ventrianal shield widened anteriorly, without separate metapodal plates; male with all dorsal shield setae (except Z_5)



Figs. 59–64. *Proctolaelaps contentiosus*: 59, female dorsum; 60, female venter; 61, female spermathecal system; 62, male dorsum; 63, male venter; 64, male chelicera.

- relatively short, not longer than the distances between the setae *rabulatus*
- Female with anterior lobes broadly connected to sternal shield, lobes with linear pattern; female without paragenital setae; male ventrianal shield parallel-sided, metapodal plates large and distinct; male with some dorsal setae enlarged and spinelike, much longer than the distance to the next posterior seta 3
3. Female with metasternal setae on platelets; male with central dorsal setae (j5–6 and J1, z5–6 and Z1, s5–6 and S1) very large and spinelike, and posterior dorsal and marginal setae (except Z5) all very short (S2–3 similar in length to S5) 4
- Female with metasternal setae on membranous cuticle, metasternal platelets absent; male with central dorsal setae variably formed, and with some posterior and/or marginal setae very large and spinelike (S2–3 at least twice as long as S5) 5
4. Both sexes with dorsal seta j2 similar in length to j1; female with maturation pouch of spermathecal system very short, only slightly longer than wide; male with dorsal setae z2, z3, and s3 very short, not longer than distance to next posterior seta *kirnseai*
- Both sexes with dorsal seta j2 approximately twice as long as j1; female with maturation pouch of spermathecal system about 2.5 times longer than wide; male with dorsal setae z2, z3 and s3 enlarged and spinelike, longer than the distance to the next posterior seta *jurgatus*
5. Both sexes with dorsal setae z3 absent; female with all marginal setae except r2–3 off the dorsal shield, posterior submarginal (UR) setae and ventral seta Jv4 long and spinelike, longer than distance to next posterior seta; male with 3 pairs of posterior marginal setae (R1–3) enlarged and spinelike, longer than adjacent setae S1–3, other posterior marginal setae (R4–7) absent *mermillion*
- Both sexes with dorsal setae z3 present; female with all marginal setae except R7 on dorsal shield, posterior submarginal setae and ventral seta Jv4 shorter than distance to next posterior seta; male with at least 5 pairs of posterior marginal setae, all posterior marginals relatively short; posterior setae S2–3 very large and spinelike, at least 5 times longer than adjacent marginal setae R2–3 *glaucis*
6. Female dorsal shield length less than 480 μm ; male spermatodactyl length 100–105 μm *contumex*
- Female dorsal shield length greater than 520 μm ; male spermatodactyl length greater than 130 μm 7
7. Female dorsal shield length 585–644 μm ; male spermatodactyl length 160–165 μm *contentiosus*
- Female dorsal shield length less than 585 μm , male spermatodactyl length greater than 170 or less than 150 μm 8
8. Female with anterior marginal seta r3 distinctly longer than adjacent marginal setae r2 and r4; male spermatodactyl length 180–185 μm ... *certator*
- Female with anterior marginal seta r3 similar in length to r2 and r4; male spermatodactyl length 140 μm *belemensis*

ACKNOWLEDGMENTS

We were assisted in the collection of specimens in Trinidad by David S. Dobkin, Amy Heyneman, and Peter Feinsinger. Accommodations were provided by the Asa Wright Nature Center, Jack Price, station manager. Dr. Alex Fain, then of the Prince Leopold Institute for Tropical Medicine, Antwerp, Belgium, graciously provided specimens of described species for comparison. Margaret Lentell and Robert Naczi helped prepare specimens. The late June O'Connor prepared most of the original illustrations, and Margaret van Bolt prepared the plates. Dr. Marek Kaliszewski, Brigham Young University, reviewed the manuscript. Grant support for this study was provided by the National Science Foundation (DEB 78-12038 and BSR 8906228) to RKC.

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Received 25 September 1990

Accepted 12 July 1991